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Flower Growing

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PREFACE

For the reader's convenience the information contained in this bulletin is arranged topically under the various practices of gardening. Such topics as soils, propagation, use of plants, and storage include under each head the recommendations for each type of garden flower discussed. In addition to the general information contained, experimental data are presented under specific crops.

FLOWER GROWING

ALEX LAURIE, V. H. RIES, L. C. CHADWICK, AND G. H. POESCH

Successful culture of flowering plants in the garden depends upon knowledge of plant adaptation to environmental conditions. Soil and its fertility, moisture requirements, the proper season for planting, the means of reproduction, and the care necessary during the growing and dormant periods constitute the factors which are primarily responsible for the well being of garden plants.

SOILS

For ages the soil has been recognized as the source from which plants draw their sustenance. The beginnings of soil go back to the remote ages when the particles of sand, grit, or clay split off from the parent rock and began their movement to the present locations, through the agency of water, wind, and glacier. Many of their properties were determined during this wandering process. The mineral particles alone do not constitute the soil. Decaying animal and plant remains form an important part of it, as well as the microorganisms inhabiting it. While living the plants build up complex organic matter, but upon death these substances are disintegrated and become part of the soil medium. The process may be observed readily upon any landslide. After the top soil has slipped, the virgin soil is exposed and vegetation springs up gradually on it. This vegetation dies and, together with the process of weathering, changes the character of the soil, thus making possible a very different type of vegetation.

The soils with which the average gardener deals may be classified for simplicity as sand, sandy loam, silt loam, clay loam, and clay, in order of their increasing compactness. Pure sand alone has very little value as a medium for plant growth. The small particles of quartz or other minerals contain no nutrient elements in available form. The various loams and clays are heavier and are composed of the mineral, as well as organic, compounds which are useful in producing plants. Differences in root systems, as well as individual nutrient needs, determine to what kind of soil various plants are best adapted.

The object of soil treatment is two-fold. It concerns structure and it concerns certain chemical substances. Manures are more valuable for their effect on structure and, therefore, on water-holding capacity, aeration, and activity of soil organisms than for the actual nutrients they contain, unless used in very large quantities. The same is true of leaf mold, rotted sod, green manure crops, and of all materials constituting "organic matter". The inorganic materials added as "commercial fertilizer" represent direct increases in the chemical ingredients which are true nutrients to the plant. A few materials, such as lime, may be added as correctives and may be beneficial, though they have little actual nutrient value.

The making of artificial manure.—In localities where barnyard manure is not available and peat too costly, artificially-made manure may be substituted. Straw, hay, leaves, or other quickly decaying vegetable matter may be used for the purpose. Additional requirements for success include abundance of

water, favorable temperatures, and additions of nutrients for the sustenance of decomposing bacteria. The directions for making such a compost pile are as follows: In the spring of the year get a ton of straw and a mixture of fertilizers (60 pounds ammonium sulfate, 30 pounds superphosphate, 25 pounds potassium chloride, and 50 pounds ground limestone) and start the pile by placing a layer of straw 4 inches thick, 4 feet wide, and any convenient length. On this first layer of straw sprinkle a portion of the fertilizer mixture and soak thoroughly with water. The procedure is repeated until the pile is 4 feet high, with a dished-in top. With plenty of water added for the next 3 months a completely decomposed material should result, with a total weight of about 3 tons. Such a compost will be free from weeds and odors and will have a composition similar to the average barnyard manure.

Tilth of soil.—To be in a suitable condition for plant growth a soil should have a good structural condition; that is, the particles should be so arranged as to hold abundant moisture, to permit aeration, to encourage the absorption and transfer of heat, and to allow easy root penetration.

By spading, raking, and cultivating heavy soils, the particles are induced to cling together in small, porous clusters called granules. This is the most desirable structural condition for easy penetration by the roots, for the absorption of rainfall, and for the holding of this moisture in available condition. A soil rich in decayed organic matter is much more easily maintained in a granulated condition than is one deficient in this material.

A poorly aerated soil produces unsatisfactory growth of plants. Well granulated and thoroughly cultivated soils reduce the toxic gases, such as carbon dioxide, and increase the oxygen content to a point needed for the best development of bacteria and growth of roots. During cold, backward springs, plants start growth slowly. This delay is due to the fact that life processes proceed at a slow rate until certain temperatures are reached. Soils attain a suitable temperature for germination of seeds and growth of plants, depending on their natural properties. Sandy soils conduct heat readily; whereas peaty soils are poor heat conductors.

I. ANNUALS

A thorough preparation of the soil is essential; this may be done either in the fall or in the spring. A light loam is suitable for the majority of annuals, provided a dressing of 2 inches of manure, peat, or leaf mold is incorporated in the soil yearly. Many annuals are partial to limed soil; so, if the soil reaction is highly acid, additions of ground limestone may be made every 2 or 3 years at the rate of 5 to 10 pounds to 100 square feet, according to the tested reaction of the soil.

The plants requiring an alkaline condition are alyssum, candytuft, carnation, Impatiens, mignonette, nasturtium, pansy, phlox, poppy, sweet pea, and Zinnia. Those but slightly affected by acidity include Ageratum, asters, Calendula, Gaillardia, Lobelia, Petunia, and Salvia. Some that tolerate acidity are castor-bean, Calliopsis, marigold, Nicotiana, and Verbena. The following annuals will grow fairly well even in the poorest of soils: alyssum, balsam, bachelor button, California poppy, Calliopsis, Godetia, Amaranthus, Nigella, nasturtium, and Portulaca.

After planting, a mulch of peat has been found advantageous in many cases (Fig. 1). Tests indicate that a large majority of annuals is benefited by this treatment. Peat mulch keeps the soil cool and furnishes nitrogen,

particularly if manure has been incorporated with the soil previously to add the needed bacteria which act upon the peat and release the nitrogen. Some annuals (Mesembryanthemum, Portulaca, poppy, etc.) prefer high temperatures and require no mulch. Further applications of fertilizer depend upon the nature of the nutrient supply. If vigorous growth develops, no further additions are needed. Stunted growth, yellowing of foliage, and failure to bloom, not due to a diseased condition or to attacks by insects, indicate the need of

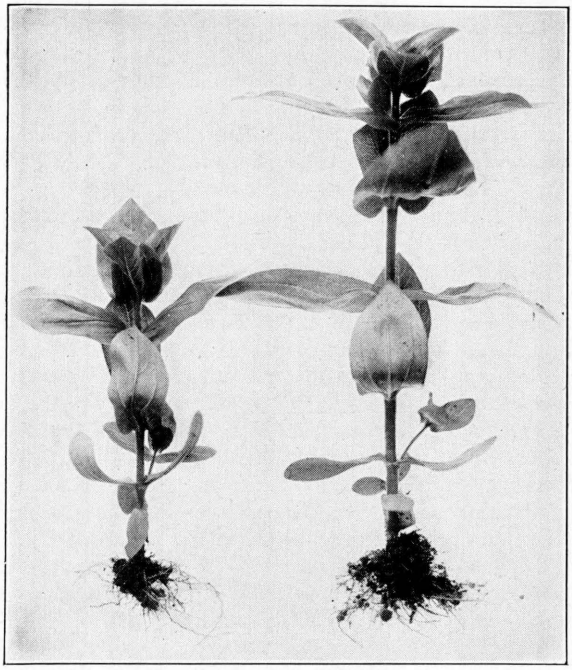

Fig. 1.—Effect of peat mulch on Zinnia.
Left—untreated. Right—mulched

additional nutrients. The application of superphosphate at the time of planting may be found desirable. Early in July and again in August, a complete fertilizer mixture should be added in dry form; care should be taken not to get the material on the foliage. Very fine results have been obtained through the use of a 4-12-4 or a similar material at the rate of 2 pounds to every 100 square feet. Many of the better commercial fertilizers sold under trade names contain the necessary elements in the ratio of 4-12-4 and are very satisfactory if used according to directions.

II. HERBACEOUS PERENNIALS

Preparation of the soil for herbaceous perennials does not differ essentially from that for annuals, except that it should be even more thorough, since the plants remain in the ground for a number of years. Preparation to considerable depth is essential. The majority of the plants should have an occasional application of lime, although a few (including Baptisia, Coreopsis, Platycodon, and Silene) are acid-tolerant.

To maintain the proper physical condition of the soil, the winter mulch of manure, leaves, or peat should be worked into the soil in the spring. Applications of complete fertilizers in dry form during the season of growth are beneficial. Two applications, one in June and another in July, of a 4-12-4 mixture may be made at the rate of 2 pounds to 100 square feet. Late summer and fall applications are not advised, since the resulting succulent growth would leave the plants in an immature condition for winter.

III. ROSES

Roses will grow in any well prepared soil, provided drainage and fertility are maintained. Clay soils have been favored because of their water-holding capacity and the sufficiency of phosphorus and potash supply. Sandy soils may be made sufficiently retentive of moisture for the growth of roses by the addition of humus and may be made fertile through the use of commercial fertilizers.

In making rose beds, either manure or peat, or a combination of the two, should form at least one-fourth of the total soil.

In the spring, as soon as growth starts, superphosphate (4 pounds to 100 square feet) should be applied. If bonemeal (5 pounds to 100 square feet) is preferred, it should be applied in the fall. Two or 3 weeks later, potassium chloride should be added in liquid form at the rate of 1 ounce to 2 gallons of water. One gallon supplies enough for 6 square feet. As a substitute for this 2 or 3 ounces of unleached hardwood ashes may be applied to each plant. A week later nitrogenous fertilizers should be applied in liquid form and followed with similar doses every 2 weeks; urea (1 ounce to 5 gallons), ammonium sulfate (1 ounce to 2 gallons), nitrate of soda (1 ounce to 2 gallons), and potassium nitrate (1 ounce to 3 gallons) are all useful for this purpose. To eliminate these frequent applications complete fertilizers may be used two or three times during the season, 4-12-4 or a similar ratio being the best mixture. The amounts of application should be the same as advocated for the annuals. A mulch of well-rotted manure or peat is very helpful during the summer in maintaining fertility, retaining moisture, and keeping down weeds. Liming is not necessary unless the soil is highly acid.

IV. PLANTS WITH SPECIALIZED SUBTERRANEAN PARTS

IRIS

Although iris will grow in any kind of soil, a medium loam is best. Even heavy clay will produce good plants and excellent bloom if it is well drained and limed. In heavy soil, plantings require a longer period to become established, but satisfactory growth is maintained for a longer period without division. For the production of rhizomes, sandy soils should be utilized.

The best method of soil preparation is to incorporate manures or green crops the season before the iris is planted. Bone or superphosphate (5 pounds to 100 square feet) should be added to the soil before the rhizomes are set. Additional commercial fertilizers should be applied once during the period of growth before flowering in the spring and again after blooming. The first application may be of nitrogenous nature, in the form of liquid urea or nitrate, used at the rate of 1 ounce to 5 gallons; the soil should be drenched. The second application should be composed of phosphorus (4 pounds) and potash (1 pound) to every 100 square feet. In place of these elements a complete mixture will be found satisfactory (See Annuals).

PEONY

Peony flowers are produced best in a rather heavy loam with a clay subsoil, provided it is not impervious to water and drains well. For the development of the roots and for propagating purposes, a light soil should be utilized. Very deep preparation is necessary, since the roots are usually planted so that the crown is fully 2 inches below the surface of the soil. Well-rotted manure should be incorporated with the soil and lime applied at the rate of 5 pounds to 100 square feet where the soils are acid. Bonemeal or superphosphate, as well as potash, should be added to the soil before planting. A 2-10-10 mixture is excellent for peonies. It should be applied once after blooming in the summer and may also be used very early in the spring as soon as growth shows above ground. Bonemeal should be applied each fall, or superphosphate (4 pounds to 100 square feet) should be added in the spring. The latter will secure earliness of bloom, which is often desirable.

If a mulch of manure is placed over the plants in the fall, it should be incorporated into the soil in the spring. Beginning when the buds form, applications of a nitrogenous fertilizer once a week will increase the size of flowers; for this purpose, urea (½ pound to 100 square feet) or ammonium sulfate (1 pound to 100 square feet) gives satisfactory results. Dried blood and tankage may be substituted for these when used at the rate of 2 pounds to 100 square feet.

SPRING-FLOWERING BULBS AND CORMS

The major bulbous crops, such as tulips, narcissi, and hyacinths, as well as those of less importance (Ixia, grape hyacinth, Scilla, crocus, etc.), do well on silt or sandy loams which are well drained. Soils which produce good crops of grain or vegetables are suitable for bulbs. The culture of bulbs should not be attempted in soils where water will not drain away readily to a depth of 20 to 24 inches.

The safest procedure in securing fertility is to apply fertilizers to the crop which precedes the bulbs. Manure should be incorporated for the preceding crop, but superphosphate and potash may be used just before planting in the fall. If it has been impossible to follow this practice, very fine, well-decomposed manure may be mixed thoroughly in the soil before planting. Fermenting particles in the soil often start basal rots which cause the young roots to decay and this decay extends to the base of the bulb.

If the soil is in good tilth and contains a sufficient amount of humus, commercial fertilizers should be applied during the second season of bulb development and, if the crop is grown for cut flowers only, every season. The application should be made early in the spring and should consist of a complete commercial fertilizer (such as 2-10-10), high in phosphorus and potash, or a more balanced material (like 4-12-4), applied at the rate of 2 pounds to 100 square feet. Because of its slow availability, bonemeal should be applied in the fall.

LILY

Lilies are benefited by deep (10 to 12 inches) soil preparation. Sandy loams are suited to the Madonna lily; whereas clay loams are better for the majority of lilies, and peaty soils are preferable for the Regal lily. In general, most of the lilies do well upon soils which are well drained, deeply prepared, and fertile. Manure of any kind should not come in direct contact with the

bulbs, unless it is well decayed and properly incorporated with the soil. Bonemeal should be used in the fall; superphosphate and complete commercial mixtures may be added every season in the spring. A 4-12-4 mixture has been found very useful.

DAHLIA

Light loam soils are preferable to heavy loams and clays for dahlias, although good results can be secured with the latter types if there is proper drainage and sufficient humus. Heavy soils should receive manure in the fall; with the lighter types the application may be made in the spring before planting. Like most root crops, dahlias are benefited by additions of phosphorus and potash. For this purpose, bonemeal should be added in the fall at the time of manuring or, on light soils, superphosphate in the spring, using about 5 pounds to every 100 square feet. Nitrogenous fertilizers should be avoided, except in cases where deficiency of this element is indicated by yellowing of foliage and stunted growth. This may be confused with a virus disease which results in stunting. Overdoses of nitrogen result in succulent growth, poor keeping quality of the flowers, and large roots which rot in storage. After the tops have reached about 1 foot in growth during the summer, a topdressing of commercial fertilizer should be applied at the rate of 2 or 3 ounces per plant. On lighter soils a 2-10-6 is preferable. In very sandy soils, ammonium sulfate may be used in dry or liquid form. To keep the soil cool, a mulch of well-rotted manure or peat should be applied.

TABLE 1.—Tests with Fertilizers for Dahlias

(Average of several varieties)

Treatment	Weight per clump	Length of stem	Size of flowers
	Oz.	*In.*	*In.*
1. Check	17.5	10	5.0
2. 4-12-4 (3 lb. to 100 sq. ft.)	15.0	15	6.0
3. 6-8-6 (3 lb. to 100 sq. ft.)	10.5	16	6.0
4. 15-30-15 (1 lb. to 100 sq. ft.)	12.0	20	6.5
5. Ammonium sulfate (1 lb. to 100 sq. ft.)	12.0	20	6.5
6. Superphosphate (4 lb. to 100 sq. ft.) Ammonium sulfate (1 lb. to 100 sq. ft.)	19.0	21	6.5
7. Superphosphate (4 lb. to 100 sq. ft.) Potassium chloride (1 lb. to 100 sq. ft.) Ammonium sulfate (1 lb. to 100 sq. ft.)	22.0	19	6.0
8. Paper mulch (initial application of No. 7)	26.0	16	5.5
9. Manure mulch (initial application of No. 7)	28.0	18	6.0

Treatments 2, 3, and 4 were made once in July and once in August. Treatment 5 was made twice in August. Treatments 6 and 7 were made once in July and once in August. Applications to Plots 8 and 9 were made at the time of planting.

Data show that weight and size of roots increase with additions of phosphorus and potash, as well as through the use of mulches. Length of stem and size of flower depend upon the application of nitrogen in the latter stages of plant development.

GLADIOLUS

A sandy loam, slightly acid in its reaction, is most suitable for the best development of gladiolus. Heavier soils produce better quality flowers and higher crowned corms but decrease the number of cormlets formed. The type of soil utilized should vary with the purpose of the grower. Gladiolus is acid tolerant, but, if the soil is extremely acid, a lime application is needed.

For best practice, the soil should be manured in the fall, plowed, and left rough. At this time, liming may be done. Superphosphate has been found necessary in many soils and should be worked into the soil in the spring. It has the tendency to produce earlier flowering and to increase reproduction. The best method of application is to spread it in the furrow before planting, at the rate of 5 pounds to every 100 feet of row. The material should be covered before the corms are set. With the application of manure in the fall and superphosphate in the spring, additions of other commercial fertilizers are not necessary except just before the flowering spikes appear. Then a nitrogenous fertilizer, like urea or ammonium sulfate, may be scattered along the rows at the rate of 1 pound to 100 linear feet. The use of nitrogenous and potassic fertilizers at the time of planting checks growth and is not beneficial in the production of corms or cormlets. Complete commercial fertilizers, low in these two elements, are often used by growers; 4-12-4 may be used at the same rate and in the same manner as superphosphate.

TABLE 2.—Fertilizer Test with Gladiolus

(100 corms to plot)

Treatment	Variety Schwaben			Variety Chicago White		
	Corms	Corm-lets	Stems	Corms	Corm-lets	Stems
	No.	*No.*	*No.*	*No.*	*No.*	*No.*
Check	102	160	91	114	680	103
Superphosphate (5 lb. to 100 ft.)	194	217	131	133	1250	114
Superphosphate and ammonium sulfate (applied later)	138	73	107	129	865	113
Ammonium sulfate	102	75	90	110	213	91
4-12-4	122	35	112	139	1100	113
6-8-6	143	30	114	130	144	109
Lime and ammonium sulfate	63	32	45	112	150	52
Aluminium sulfate and ammonium sulfate	94	57	85	121	205	90
Bonemeal	96	33	89	118	350	96

The amounts of materials applied were similar to those in Table 2. Except in the case of ammonium sulfate, which was added once after spikes appeared and again just before florets opened, the application was made at time of planting. The soil used was slightly acid (pH 6) in its reaction and of good fertility. The use of phosphorus (as superphosphate) increased production of corms, cormlets, and spikes. Increased alkalinity (pH 7.5) reduced production considerably. Additions of nitrogen without phosphorus were detrimental.

V. AQUATIC PLANTS

Fairly heavy, rich, clay loam soil is the best medium for proper growth and development of the majority of the water plants. Nymphaeas and Nelumbiums, in particular, are partial to such soils. A compost of one-half soil and one-half cow manure may be prepared in advance by piling it in the fall and chopping and mixing it thoroughly before filling the pool in the spring. At the same time bonemeal or superphosphate may be mixed with this compost at the rate of one 4-inch potful to a wheelbarrow of soil. A complete fertilizer analyzing 4-12-4 may be substituted for the bonemeal at the same rate. If cow manure is not available, good sheep manure may be used at the rate of one part to six of soil.

VI. ROCK GARDEN PLANTS

Excellent drainage, abundant moisture supply, and a comparatively small amount of nutrients constitute the requirements of a satisfactory soil for most rock plants. Light, loamy soils, to which peat or leaf mold is added to conserve moisture and into which small stone chips or clean gritty gravel is incorporated, produce the most satisfactory results. A mixture which will serve well for most rock garden plants may be made of one part light loam, one part sand or stone chips, and one part imported peat moss. To increase or reduce the water-holding capacity for specific plants the proportions of gravel and peat may be varied as necessary. Most rock garden plants thrive satisfactorily in slightly acid or neutral soil, but the following prefer additions of lime:

Anemone alpina
Anemone hepatica (Windflower)
Anemone pulsatilla (Pasqueflower)
Aquilegia alpina (Columbine)
Aubrietia deltoidea (Common Aubrietia)
Campanula pusilla (Bellflower)
Dianthus alpinum (Pink)
Erinus alpinus (Alpine Liver-balsam)
Gypsophila repens (Babysbreath)
Leontopodium (Edelweiss)
Saxifraga
Sempervivums (Houseleek)
Silene acaulis (Catchfly)

PROPAGATION

Garden flowers are propagated by seed or vegetatively by cuttings, division, layering, or grafting. The extent of the use of these methods varies with the different groups of flowers. With perennials all of the methods are used; whereas the reproduction of annuals is done mainly by seed.

I. ANNUALS

Most annuals are propagated by seed and may be divided into three classes: (1) tender, (2) half-hardy, and (3) hardy. The tender annuals will not do well if sown in cold soil in the spring. For early bloom they must be sown indoors early in the year, usually in March or April; but, if earliness of bloom is not a factor, seed may be sown outside after the soil becomes warm, usually during May.

TENDER ANNUALS

The tender annuals may be sown outdoors during May or earlier indoors.

Ageratum houstonianum (Floss Flower)
Callistephus chinensis (China-aster)
Celosia plumosa (Cockscomb)
Cobaea scandens (Purplebell Cobaea)
Emilia flammea (Tasselflower)
Lobelia erinus (Edging Lobelia)
Lunaria biennis (Honesty)
Mimulus luteus (Monkeyflower)
Nemophila maculata (Spotted Nemophila)
Phaseolus coccineus (Scarlet Runner Bean)
Reseda odorata (Mignonette)
Salpiglossis sinuata (Painted Tongue)
Schizanthus pinnatus (Poorman's Orchid)
Trachymene caerulea (Blue Laceflower)
Tropaeolum peregrinum (Nasturtium)

HALF-HARDY ANNUALS

Many of the half-hardy sorts require a long growing season for proper development and should be sown in March in a greenhouse, cold frame, or hotbed.

Antirrhinum majus (Snapdragon)
Arctotis grandis (Bushy Arctotis)
Centaurea cineraria (Dusty-miller)
Dianthus chinensis (Pink)
Dimorphotheca aurantiaca (Winter Cape-marigold)
Gilia capitata (Globe Gilia)
Helichrysum bracteatum (Strawflower)
Limonium (Statice)
Lobelia erinus (Edging Lobelia)
Lupinus (Lupine)
Matthiola incana (Stocks)
Nemesia strumosa (Pouched Nemesia)
Nicotiana sylvestris (Tobacco)
Pentstemon gloxinioides (Gloxinia Pentstemon)
Petunia hybrida (Common Petunia)
Quamoclit coccinea (Starglory)
Ricinus communis (Castor-bean)
Salpiglossis sinuata (Painted Tongue)
Salvia farinacea (Mealycup Sage)
Salvia splendens (Scarlet Sage)
Scabiosa atropurpurea (Sweet Scabiosa)
Verbena hybrida (Garden Verbena)
Zinnia (Youth and Old Age)

HARDY ANNUALS

The hardy annuals, which include many of the most important kinds, are sown best where they are to grow as soon as the soil can be worked in the spring. If a greenhouse, hotbed, or cold frame is available, many of these sorts may be started in flats in March and April, like the half-hardy sorts, and transplanted to their permanent place in the garden as soon as the ground is workable. Types difficult to transplant should be sown only in their permanent place. Some sorts self-sow readily; others may be sown in the fall.

ANNUALS DIFFICULT TO TRANSPLANT

Argemone grandiflora (Showy Pricklepoppy)
Eschscholtzia californica (California Poppy)
Godetia grandiflora (Whitney Godetia)
Gypsophila elegans (Common Gypsophila)
Helianthus annuus (Sunflower)
Lathyrus odoratus (Sweet Pea)
Lavatera trimestris (Herb Treemallow)
Lupinus (Lupine)
Nigella damascena (Love-in-a-mist)
Oenothera drummondi (Evening-primrose)
Papaver (Poppy)
Phaseolus coccineus (Scarlet Runner)
Portulaca grandiflora (Rose Moss)
Trachymene caerulea (Blue Laceflower)
Tropaeolum (Nasturtium)

ANNUALS WHICH OFTEN SELF-SOW

Alyssum maritimum (Sweet Alyssum)
Browallia
Calendula officinalis (Pot-marigold)
Centaurea cyanus (Cornflower)
Cleome spinosa (Spiderflower)
Coreopsis tinctoria (Calliopsis)
Cosmos bipinnatus (Cosmos)
Delphinium ajacis (Rocket Larkspur)
Eschscholtzia californica (California Poppy)
Euphorbia marginata (Snow-on-the-mountain)
Gypsophila elegans (Common Gypsophila)
Ipomaea purpurea (Common Morning Glory)
Kochia trichophylla (Common Summer-cypress)
Mirabilis jalapa (Common Four-o'clock)
Nicotiana sylvestris (Tobacco)
Petunia hybrida (Common Petunia)
Portulaca grandiflora (Rose Moss)
Salvia farinacea (Mealycup Sage)

ANNUALS THAT MAY BE SOWN IN THE FALL

Alyssum maritimum (Sweet Alyssum)
Antirrhinum majus (Snapdragon)
Calendula officinalis (Pot-marigold)
Centaurea cyanus (Cornflower)
Clarkia elegans (Clarkia)
Coreopsis tinctoria (Calliopsis)
Cosmos bipinnatus (Cosmos)
Delphinium ajacis (Rocket Larkspur)
Dianthus chinensis (Chinese Pink)
Eschscholtzia californica (California Poppy)
Gypsophila elegans (Common Gypsophila)
Iberis (Candytuft)
Lathyrus odoratus (Sweet Pea)
Lavatera trimestris (Herb Treemallow)
Nigella damascena (Love-in-a-mist)
Papaver (Poppy)
Saponaria vaccaria (Cow Soapwort)
Viola tricolor (Pansy)

ANNUALS USEFUL FOR SUCCESSION OF BLOOM

Several sowings should be made of these annuals to obtain a succession of bloom.

Alyssum maritimum (Sweet Alyssum)
Centaurea cyanus (Cornflower)
Coreopsis tinctoria (Calliopsis)
Dimorphotheca aurantiaca (Winter Cape-marigold)
Gypsophila elegans (Common Gypsophila)
Iberis umbellata (Purple Candytuft)
Myosotis (Forget-me-not)
Nigella damascena (Love-in-a-mist)
Papaver (Poppy)
Phlox drummondi (Drummond Phlox)
Reseda odorata (Mignonette)

II. PERENNIALS

Perennials are propagated by seed, cuttings, division, layering, and grafting.

SEED PROPAGATION

As a rule, perennial and alpine seeds are best sown as soon as ripe. Early blooming sorts should be propagated in the summer; later types, in autumn; and the fall-blooming kinds may be sown in the greenhouse or hotbed in winter or cold frames in the spring. Seeds sown in June and July will produce seedlings of sufficient size for potting in the fall and may be carried through the winter in protected frames.

Methods of seed propagation.—An excellent method of getting the best results from very small seeds is to use a mixture of equal parts of peat moss and sand. The seeds are sown directly on the moss and require no other

covering. A pane of glass may be placed over the pot to help maintain moisture conditions suitable for germination. The needed water should be supplied from beneath by placing the pot in a pan of water. With larger seeds the soil mixture may be coarser, consisting of equal parts of sand, peat moss, and loam. The seeds may be covered lightly with a soil mixture consisting of three-fourths peat and one-fourth loam and watered with a fine spray.

When sowing larger amounts of seed it is best to sow in flats. Small flats, 12 by 8 inches and 3 to 4 inches deep, make a convenient container. Drainage should be provided by leaving spaces between bottom boards. The soil medium should be made level and slightly compact. It is best to sow the seed in rows about 1 to 2 inches apart, depending on the variety. A temperature of 55° to 65° F. is the most favorable.

Perennial seeds may be sown directly in soil in permanent cold frames or frames specially constructed for the purpose. These special frames are constructed by putting 12-inch boards at the sides and ends of the bed. They can be built wherever there is suitable soil. The length of the frame depends on the amount of seed to be sown; the width is usually 4 feet.

A light sandy loam soil is best for seed germination and seedling growth. The soil within the frames should be several inches higher than outside to insure perfect drainage. Seeds are sown either in rows or broadcast. If the quantity is small it is usually advisable to sow in rows. The seeds are covered lightly with soil or peat moss and watered with a fine spray from a sprinkling can. If regular cold frames or hotbeds are used, a covering with sash shaded with burlap or whitewash is desirable. The sash should be raised a little during sunny days.

The seedlings should be transplanted in flats or potted when they have developed true leaves. The most vigorous sorts may be planted outside in protected beds.

PERENNIAL SEEDS WHICH LOSE THEIR VITALITY QUICKLY AND MUST BE SOWN AS SOON AS RIPE

Baptisia (Wild Indigo)
Clematis
Delphinium (Larkspur)
Dictamnus (Gasplant)
Funkia (Hosta)
Helleborus (Hellebore)

In addition to these, Bellis, Catananche, Lobelia, and Silene are others that lose their vitality quickly and are best sown in the fall.

PERENNIALS THAT WILL BLOOM THE FIRST YEAR FROM SEED

Achillea (Yarrow)
Anthemis (Camomile)
Arabis (Rockcress)
Bellis
Cerastium
Coreopsis
Gaillardia
Linum (Flax)
Lychnis (Champion)
Myosotis (Forget-me-not)
Pyrethrum
Tunica (Tunicflower)

CUTTINGS

STEM CUTTINGS

Stem cuttings are best taken with a heel and made 2 to 3 inches long. Either succulent shoots in the spring or mature stems in the fall may be used and inserted into a medium of peat moss and sand or sand alone with a slight bottom heat. Hotbeds may be used for softwood cuttings.

Bottom heat for the hotbeds may be furnished by fermenting manure or by a recent development in electric units or cable. If manure is used, 10 to 12 inches are required to furnish the necessary heat which will last for a period of 3 to 4 weeks. Several days should elapse before the cuttings are inserted to allow the temperature to go down to 70 to 75 degrees. In cases where small amounts are to be propagated, a soap box, with the bottom knocked out, may be placed over the manure and soil and a pane of glass used as a cover. Recent experiments have indicated that electricity may be used satisfactorily to furnish bottom heat for cuttings and seedbeds. Electric heat may be furnished by leaded wire cable or by units supplied by leading electrical companies. The cable should be laid on a base of cinders or gravel and the bed carefully insulated. The rooting medium is placed directly on top of the cable.

When one of the units is used, a box may be constructed in such a way that the unit may rest on supports below the rooting medium. Electric cable or units, when supplied with thermostats, are economical to operate and provide a uniform temperature very essential to the most successful development of seeds and cuttings.

Four to 6 weeks are required to root the majority of types, after which they should be potted in 2½-inch pots.

Perennials propagated by stem cuttings.—

Arenaria (Sandwort)
Artemisia (Wormwood)
Aster (various)
Aubrietia
Campanula (Bellflower)
Centaurea dealbata
Cerastium tomentosum (Snow-in-summer)
Chrysanthemum
Clematis
Daphne
Delphinium (Larkspur)
Dianthus (Pink)
Epigaea (Trailing Arbutus)
Gaillardia
Helenium (Sneezeweed)
Iberis (Candytuft)
Lupinus (Lupine)
Lythrum salicaria (Purple Loosestrife)
Myosotis (Forget-me-not)
Phlox
Pyrethrum (Painted Daisy)
Rudbeckia (Coneflower)
Salvia (Sage)
Verbascum (Mullein)
Veronica (Ironweed)

LEAF CUTTINGS

Although leaf cuttings may be used to advantage with such types as sedums, this method of reproduction is relatively unimportant.

ROOT CUTTINGS

Root cuttings may be used as a means of propagating some perennials. Medium fleshy roots are cut into 1- or 2-inch pieces and placed in soil in shallow flats in the greenhouse or planted in well prepared beds outside. Root pieces should be placed close together, but not overlapping, and covered with about ½ inch of soil. When two or three leaves have been produced, the new plants may be potted or planted directly outside in beds.

Perennials propagated by root cuttings.—

Anchusa (Bugloss)
Anemone
Asclepias (Butterflyweed)
Bocconia (Plumepoppy)
Ceratostigma
Coronilla vera (Crownvetch)
Dicentra spectabilis (Bleedingheart)
Echinops (Globethistle)
Gypsophila paniculata (Babysbreath)
Oenothera (Evening-primrose)
Papaver (Poppy)
Phlox
Polygonatum (Solomon's Seal)
Romneya (Canyon-poppy)
Stokesia (Stokes-aster)
Thermopsis
Trollius (Globeflower)
Yucca (Adam's-needle)

DIVISION

With the exception of perennials which form a distinct tap or fleshy root, division of the clumps may be used as a means of increasing the stock. The best season for division is governed by the growth and rest periods of the individual. The majority of types which have their period of rest during the winter may be divided in either fall or spring. If division is practiced in the fall, it should be done in time to allow the new clump to become established before cold weather. Spring division is ordinarily more desirable than fall. Such types as the Hepatica and others that flower early in the spring and then develop new growth and finally rest are best divided as soon as the flowering period is over. Other types, such as iris and peonies, that have their rest period in midsummer should be divided during late August and early September.

LAYERING

A few types, such as Dianthus, Nepeta, Sedum, Thymus, and Veronica, that have a distinct prostrate form may be layered. All that is necessary is to cover them partially with soil. Layering is done in spring or fall and the new plants may be severed at the end of the following growing season.

GRAFTING

The double flowering forms of *Gypsophila paniculata* and the tree peony can be satisfactorily produced only by grafting. Since this method of production requires considerable equipment and skill, it is not recommended for the average gardener.

III. ROSES

Roses are propagated by seed, root sprouts, suckers, layers, hardwood and softwood cuttings, budding, and grafting. The production of roses by seed, budding, and grafting is employed extensively on a commercial scale, but the skill and equipment required for success preclude this as a general practice by the home gardener.

Root sprouts and layers.—Many species, such as *Rosa blanda, R. carolina, R. lucida, R. nitida, R. rugosa, R. setigera, R. spinosissima,* and *R. wichuraiana,* are propagated by root sprouts or layers. Sprouts may be separated and planted either in the spring or fall. The process of layering is simple and involves the notching of the stem on the underside, bending it to the ground, and covering with soil early in the summer. By fall or the following spring, these buried sections will have rooted and may be severed and transplanted.

Hardwood cuttings.—Climbing roses, hardy landscape roses, and Hybrid Perpetuals are often propagated by hardwood cuttings. These are taken in the fall of the year from well ripened wood and cut in sections of 6 to 8 inches in length. The best guide to the time of taking is the dropping of the foliage after the first frost. These cuttings should be tied in bundles, a label attached, and the bundles buried in sand in a cold cellar or out-of-doors deeply enough to avoid freezing. The recommendation often made relative to placing of the butts up and tips down when burying is not essential. The bundles may be buried horizontally with equally desirable effect.

In the spring of the year these cuttings should be planted 4 to 6 inches apart and deep enough so that only an inch of the cutting with a single bud shows above the ground.

Softwood cuttings.—These cuttings may be made in late June and July from wood of the current year's growth. They should contain three buds. The leaves should be taken off the two lower ones and partially trimmed off the upper one. They should be inserted in sand in a hotbed and kept close and moist to hasten rooting. Shade to reduce evaporation, moisture to prevent wilting, and bottom heat to hasten rooting are the essentials for success. After rooting, the cuttings should be potted and kept shaded and close until proper root action has taken place.

If a hotbed or cold frame is not available, a box of sufficient size to hold 3 to 4 inches of sand and have an air space of 6 to 8 inches above the rooting medium, and one that may be covered with glass may provide conditions essential to produce rooting.

IV. ROCK PLANTS

Rock plants are propagated mainly by seeds and stem cuttings. Although these practices do not differ from the operations discussed under perennials, it should be remembered that many of the seeds and seedlings of these plants are very delicate and should be given the best of care and attention. The method used for handling very small seeds of perennials will suffice for many of the rock plants. Some of the alpine plant seeds require a definite period of rest and after-ripening. Such types should be stratified in boxes or flats of equal parts of sand and peat moss and stored over winter in a cool place. To aid in the removal of the seeds in the spring they should be placed between two layers of muslin. An inch and a half of the stratification medium below and above the muslin is sufficient. Storage of the flats in a cool cellar or shed at approximately 40° F. is best. If stored in sheds where the temperature is apt to drop below 35° F., they should be covered with leaves or straw.

V. WATER PLANTS

Water plants are propagated by seed, division, and tubers. Seeds of water lilies should be sown in seed pans containing good soil and covered with about ¼ inch of sand. The pan should be gradually submerged in a tank of water until it is about 2 inches below the surface. The tank should be placed in full sun and the temperature of the water maintained at about 70° F. When the first floating leaf appears the seedlings should be potted in good soil. Seeds of many of the hardy water lilies germinate very slowly and may require from 3 to 8 months for the process.

Division of hardy water lilies may be practiced during the active growing stage in spring or in August. Types with single fleshy roots should not be divided. The tender lilies produce small tubers at the base of the old rhizomes. These tubers may be removed and stored in sand until February when they should be potted and placed in tanks.

Some tender water lilies send out runners when potted in midwinter and submerged in water at 75-80° F. These may be removed and potted after a few leaves and a mass of roots have been produced. Re-potting and feeding are necessary to avoid the checking of growth.

VI. BULBS, ROOTS, TUBERS, AND CORMS

LILY

Lilies may be produced by seed sown in November to January in a warm place and handled the same as perennial seed; by scale cuttings, the outer thick scales being broken off in midsummer and planted in rows in protected beds or flats where they will establish roots by October; by layering stems; and by stem bulblets. The stems of some types may be twisted from the bulb after flowering and buried erect in a dry, sandy soil. After a 2- to 3-month period there will have been produced in the axils of the leaves small bulblets which can be removed and sown as one would seeds of garden peas. Some types, such as *Lilium bulbiferum* and *L. tigrinum*, normally produce aerial bulblets which may be handled in the same way.

TULIP AND NARCISSUS

Tulip and narcissus bulbs normally produce offsets which may be separated from the mother bulb and planted. Two to 3 years' growth is necessary for the production of good flowers from these "splits".

HYACINTH

In the production of hyacinths scooping and scoring are practiced to hasten the production of new bulblets. Separation of the normally produced bulbs is a practice to be followed by the amateur.

GLADIOLUS

Gladioli are produced by the separation and planting of the new corms and cormlets produced at the base of the stock just above the old corm. The cormlets are planted in the spring and will form flowering sized corms in a period of 2 to 3 years. Division of mature corms is also used. Each large corm may be cut in two, each half containing a bud at the top and a piece of the old base at the bottom.

TABLE 3.—Aids in Germination of Gladiolus Cormlets

Treatment	Days to germinate	Percentage germination
Shucked	52	56
Sulfuric acid (70%)—20 min	53	45
Sulfuric acid (70%)—15 min	60	48
Sulfuric acid (70%)—10 min	60	52
Sulfuric acid (70%)— 5 min	64	24
Acetic acid (5%)—1 day	64	48
Acetic acid (5%)—2 days	64	39
Acetic acid (5%)—3 days	64	32
Soaked in water— 2 days	64	40
Soaked in water— 4 days	52	50
Soaked in water— 6 days	64	38
Soaked in water— 8 days	64	32
Soaked in water—13 days	64	25
Untreated (check)	60	30

Much difficulty is frequently experienced in securing proper growth of gladiolus cormlets after storage during winter. To hasten this process and secure a greater percentage of germination, some tests were made on the effect of treating cormlets with a number of materials. Mrs. Norton and Purple Glory were the varieties used, both being extremely difficult to germinate.

The term "shucked" means the cutting of the outer covering before planting. Sulfuric acid was used in its full commercial strength (70%). The data show that "shucking" is the best but most tedious procedure and that the use of a 10-minute dip in commercial sulfuric acid, followed by rinsing, is the most satisfactory procedure. Soaking in water for 4 days and the use of acetic acid, 5% (vinegar), are also justified. The difference obtained between the untreated cormlets and the others was sufficiently high to warrant the use of artificial stimulation, the action of which depends upon softening the outer coats.

DAHLIA

Dahlias may be propagated by seed, division, and cuttings. The seed is usually sown about the first of March in a warm place and handled in much the same manner as the seed of perennials. Dahlias are commonly propagated by division of the old clumps into several pieces, each containing a piece of the stem bearing the eyes near its junction with the roots. It is imperative that each new piece have at least one good eye. The entire clump or division may be stored over winter in dry sand or peat at a temperature of about 40° F. Division is best practiced in the spring a short time before planting.

A large supply of stock may be obtained easily by propagating by cuttings. The old clumps are placed in flats covered with peat or soil in a hotbed or warm greenhouse. A slight bottom heat and humid atmosphere will hasten development. When the new shoots have developed 6 to 8 inches of growth (about three eyes), they can be removed and handled as other softwood cuttings. When removing the cuttings, if the cut is made through or just above a node, additional shoot growth will be produced on the stock plants and another crop of cuttings can be obtained.

USE AND PLANTING

I. ANNUALS

Most of the annual flowering plants are so vivid in their colors and are used in such large masses that more care is probably required to avoid poor color combinations than with other classes of plants. When used in clumps in shrubbery beds so that there is other foliage to separate the colors, there is much less danger of getting clashing combinations than when large masses of different kinds of annuals are used in a garden or in a single border. The colors found in the different varieties of a single species usually do not clash.

Annuals lend themselves to many uses, such as backgrounds or screens, foregrounds, interplanting with perennials or shrubs, rock gardens, porch boxes, and scores of other places. Spring-flowering bulbs and annuals make a good rotation.

Planting.—Annuals should not be planted out-of-doors until all danger of frost is past, which will vary from May 1 until June 1. Annuals that have been grown in 2½-inch pots will transplant more easily than those grown in flats or beds. For transplanting, a cloudy day should be chosen.

For formal beds, definite rows should be followed. The distance of planting varies with the type of annual. The small-growing species should be planted 6 by 6 inches; the medium-sized species, such as snapdragons and French marigolds, should be spaced 8 by 8. Zinnias, salvia, and African marigolds sould be placed 12 inches or more each way.

In planting annuals in vacant spaces in rock gardens or perennial borders, a group of five or seven plants will present a more pleasing effect than will single plantings. All annuals should receive a liberal amount of water after they are transplanted.

The annual beds should be watched closely so that weeds do not overtake the young plants. Cultivation after each rain is recommended. Annual plants should never be allowed to remain dry.

EDGING ANNUALS

Edging plants should be short and compact and should continue to flower the entire season. The following are the best for this purpose:

Ageratum nanum compactum (Little Bluestar Ageratum)
Ageratum (Tom Thumb Little Bluestar)
Alyssum maritimum (Sweet Alyssum)
Celosia lilliput (Fire Feather)
Centaurea cineraria (Dusty-miller)
Lobelia erinus Crystal Palace (Edging Lobelia)
Petunia hybrida (Common Petunia)
Phlox drummondi (Drummond Phlox)
Portulaca grandiflora (Common Portulaca)
Tagetes signata pumila (Striped Marigold)
Tropaeolum majus (Common Nasturtium)
Verbena hybrids (Garden Verbena)
Viola tricolor (Common Pansy)

ROCKERY ANNUALS

Dwarf, compact, and not-too-spreading annuals are good rock garden plants. Among the best for this purpose are:

Abronia umbellata (Pink Sandverbena)
Ageratum houstonianum (mexicanum) (Mexican Ageratum)
Alyssum maritimum (Sweet Alyssum)
Antirrhinum (dwarf) (Snapdragon)
Browallia speciosa major
Dianthus chinensis (Chinese Pink)
Dimorphotheca aurantiaca (Winter Cape-marigold
Emilia flammea (Tasselflower)
Eschscholtzia californica (California Poppy)
Gazania longiscapa
Hunnemannia fumariaefolia (Goldencup)
Iberis umbellata (Purple Candytuft)
Lobelia erinus (Edging Lobelia)
Petunia hybrida (Petunia)
Phlox drummondi (Drummond Phlox)
Portulaca grandiflora (Rose Moss)
Sanvitalia procumbens (Common Sanvitalia)
Silene armeria (Sweet-william Campion)
Tagetes signata pumila (Dwarf Marigold)
Verbena hybrida (Garden Verbena)
Verbena venosa (Tuber Verbena)
Viola tricolor (Common Pansy)

ANNUALS FOR SHADY LOCATIONS

Annuals are not lovers of shade, but a few succeed under partial shade. The following sorts may be recommended:

Alyssum maritimum (Sweet Alyssum)
Antirrhinum majus (Snapdragon)
Centaurea americana (Basketflower)
Centaurea imperialis (Royal Sweet-sultan)
Centaurea suaveolens (Sweet-sultan)
Clarkia elegans
Cynoglossum amabile (Chinese Forget-me-not)
Eschscholtzia californica (California Poppy)
Godetia amoena (Farewell-to-spring)
Lupinus hartwegi (Hartweg Lupine)
Myosotis palustris (True Forget-me-not)
Phlox drummondi (Drummond Phlox)
Viola tricolor (Common Pansy)

ANNUALS FOR WINDOW AND PORCH BOXES

Ageratum houstonianum (mexicanum caeruleum) (Mexican Ageratum)
Alyssum maritimum (Sweet Alyssum)
Browallia speciosa
Centaurea cineraria (Dusty-miller)
Lantana camara (Common Lantana)
Lobelia erinus (Edging Lobelia)
Maurandia barclaiana (Barclay Maurandia)
Petunia hybrida (Petunia)
Phlox drummondi (Drummond Phlox)
Portulaca grandiflora (Rose Moss)
Tagetes signata pumila (Dwarf Marigold)
Thunbergia alata (Black-eyed Clockvine)
Verbena hybrida (Garden Verbena)
Vinca rosea (Madagascar Periwinkle)

ANNUALS THAT WILL GROW IN POOR SOIL

Alyssum maritimum (Sweet Alyssum)
Amaranthus caudatus (Love-lies-bleeding)
Browallia speciosa
Calendula officinalis (Pot-marigold)
Celosia plumosa (Feather Cockscomb)
Centaurea moschata (Sweet-sultan)
Cleome spinosa (Spiderflower)
Coreopsis tinctoria (Calliopsis)
Eschscholtzia californica (California Poppy)
Gaillardia lovenziana (Gaillardia)
Godetia grandiflora (Whitney Godetia)
Impatiens balsamina (Garden Balsam)
Mentzelia aurea (Bartonia) (Blazing Star)
Mirabilis jalapa (Common Four-o'clock)
Papaver rhoeas (Corn Poppy)
Petunia hybrida (Petunia)
Portulaca grandiflora (Rose Moss)
Tropaeolum majus (Nasturtium)

ANNUALS FOR HOT, DRY PLACES (DROUTH RESISTANT)

Argemone grandiflora (Showy Pricklepoppy)
Centaurea cyanus (Cornflower)
Convolvulus tricolor (Dwarf Convolvulus)
Coreopsis tinctoria (Calliopsis)
Delphinium ajacis (Rocket Larkspur)
Dimorphotheca aurantiaca (Winter Cape-marigold)
Euphorbia marginata (Snow-on-the-mountain)
Helianthus annuus (Common Sunflower)
Ipomoea purpurea (Morning Glory)
Kochia trichophylla (Common Summer-cypress
Mesembryanthemum crystallinum (Ice Plant)
Mirabilis jalapa (Common Four-o'clock)
Perilla frutescens (Green Perilla)
Phlox drummondi (Drummond Phlox)
Portulaca grandiflora (Rose Moss)
Salvia splendens (Scarlet Sage)
Sanvitalia procumbens (Common Sanvitalia)
Zinnia elegans (Common Zinnia)

FRAGRANT ANNUALS

Alyssum maritimum (Sweet Alyssum)
Antirrhinum majus (Snapdragon)
Centaurea moschata (Sweet-sultan)
Delphinium ajacis (Rocket Larkspur)
Dianthus chinensis (Chinese Pink)
Heliotropium peruvianum (Common Heliotrope)
Iberis umbellata (Purple Candytuft)
Lathyrus odoratus (Sweet Pea)
Lupinus luteus (European Yellow Lupine)
Matthiola incana (Common Stock)
Mimulus moschatus (Muskplant)
Nicotinana affinis (Jasmine Tobacco)
Phlox drummondi (Drummond Phlox)
Reseda odorata (Mignonette)
Scabiosa atropurpurea (Sweet Scabiosa)
Tropaeolum majus (Nasturtium)
Verbena hybrida (Garden Verbena)
Viola tricolor (Common Pansy)

ANNUALS SUITABLE FOR CUT FLOWERS

Antirrhinum majus (Snapdragon)
Arctotis grandis (Bushy Arctotis)
Browallia speciosa
Calendula officinalis (Pot-marigold)
Callistephus chinensis (China Aster)
Centaurea cyanus (Cornflower) and imperialis (Sweet-sultan)
Chrysanthemum
Coreopsis tinctoria (Calliopsis)
Cosmos bipinnatus (Common Cosmos)
Delphinium ajacis (Rocket Larkspur)
Dianthus chinensis (Chinese Pink)
Dimorphotheca aurantiaca (Winter Cape-marigold)
Gaillardia lorenziana (Gaillardia)
Iberis umbellata (Purple Candytuft)
Lathyrus odoratus (Sweet Pea)
Limonium sinuatum (Notchleaf Sea-lavender)
Phlox drummondi (Drummond Phlox)
Reseda odorata (Mignonette)
Salpiglossis sinuata (Scalloped Salpiglossis)
Scabiosa atropurpurea (Sweet Scabiosa)
Schizanthus pinnatus (Wingleaf Butterflyflower)
Tagetes erecta (Aztec Marigold (African) and patula (French Marigold)
Tropaeolum majus (Nasturtium)
Verbena venosa (Tuber Verbena)
Viola tricolor (Common Pansy)
Zinnia elegans (Common Zinnia)

TYPES FOR FOLIAGE EFFECTS

Amaranthus caudatus (Love-lies-bleeding)
Argemone grandiflora (Showy Pricklepoppy)
Briza maxima (Big Quaking Grass)
Cardiospermum halicacabum (Balloonvine)
Coix lacryma (Jobs-tears)
Coleus blumei (Common Coleus)
Euphorbia marginata (Snow-on-the-mountain)
Kochia trichophylla (Common Summer-cypress)
Lagurus ovatus (Rabbittail Grass)
Perilla frutescens (Green Perilla)
Ricinus communis (Castor-bean)

TYPES FOR WINTER BOUQUETS—EVERLASTINGS

Ammobium alatum (Winged Everlasting)
Celosia cristata (Common Cockscomb)
Gomphrena globosa (Common Globe-amaranth)
Gypsophila elegans (Common Gypsophila)
Helichrysum bracteatum (Strawflower)
Helipterum manglesi (Mangles Everlasting)
Helipterum roseum (Rose Everlasting)
Lunaria biennis (Honesty)
Limonium sinuatum (Notchleaf Sea-lavender)
Xeranthemum annuum (Common Immortelle)

GROWING ANNUALS UNDER CLOTH

Due to the difficulties encountered in growing many annual flowering plants because of insect depredations, new methods of culture have been devised. One of these is the use of a cloth enclosure. Such enclosures have proven their worth in combating aster yellows, caused by one species of leafhopper (*Cicadula sexnotata*), as well as the attacks of the tarnished plant bug (*Lygus pratensis*) and the blister beetle (*Epicauta pennsylvanica*).

Jones[1] reported that a 22 x 22-mesh per inch cloth proved very satisfactory in the prevention of leafhopper entrance. Post[2] found that similar cloth (tobacco cloth) was also instrumental in eliminating entrance of tarnished plant bug and blister beetle. Ball[3] has used this cloth protection with success in the commercial production of asters.

Tests were also conducted by the Department of Horticulture, of the Ohio Agricultural Experiment Station, to determine the feasibility of the use of cloth enclosures, not only from the standpoint of disease and insect control but also from the increased growth and development secured under such conditions.

These tests were conducted in three plots: (1) Under natural conditions outdoors, (2) under white cloth, and (3) under a yellow cloth impregnated to withstand deterioration due to climatic factors of light, wind, and water. Twenty-two varieties of asters, 13 kinds of annuals, and 11 varieties of pompon chrysanthemums were used in these tests.

Construction of the cloth enclosure.—The most satisfactory way to construct such a structure is to make the house 33 feet wide and any desired length. Place 10-foot posts, 16½ feet apart, around the sides of the house, having the posts extend 6 to 7 feet above the level of the soil. The posts in the center of the house should be 33 feet apart. Number 10 galvanized wire should be placed through the top of the post, leaving several inches of the post extending above the wire. This wire is attached to short, 4 x 4-inch pieces which have been placed horizontally at a depth of 2½ feet below the soil level. Cross wires are constructed in a similar fashion. Six-inch baseboards are then nailed to the base of the posts.

In sewing the cloth to the wire, the top, or 400-inch wide strip, should be attached first. For best results a calm day should be chosen. The lock stitch is used because it holds the cloth firmly to the wire and is quickly made. About 4 inches of the cloth should be rolled firmly around the wire. It is well to attach this first with clothes pins or nails while sewing the top cloth to the wire. The side cloth is then sewed to the top wire and the lower end is tacked to the baseboard. It is very important that the cloth be sewed very close to the posts; this eliminates holes. An old innertube will work very satisfactorily about the posts near the cloth as insurance against tearing.

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[1]Jones, L. R. and Regina S. Riker. 1931. Wisconsin studies on aster diseases and their control. Wisc. Agr. Exp. Sta. Res. Bull. 111.

[2]Post, Kenneth. 1932. Summer annuals. Proc. Amer. Soc. Hort. Sci. 28: 393-397.

[3]Ball, G. J. 1930. Asters under tent safe from hopper. Florists' Rev. 23: Oct.

Two kinds of cloth were used, one which was yellow and had reinforcements every 12 inches and one which was white and did not contain as much reinforcement as the other.

Fig. 2.—*Top.*—Asters growing under cloth. *Bottom.*—The effect of shading on pompon chrysanthemums. Foreground—shaded plot in flower. Background—normal plot, taller in growth but several weeks later in flowering.

TABLE 4.—Comparison of the Production of Disease-resistant and Non-resistant Strains of Asters Grown Under Yellow Cloth, White Cloth, and Out-of-doors

Variety	Wilt resistance			Average flowers per plant			Average stem length			Average flower diameter		
	Yellow	White	Open	Yellow	White	Open	Yellow	White	Open	Yellow	White	Open
	Pct.	*Pct.*	*Pct.**	*No.*	*No.*	*No.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Ball's White (Non-Res.)...	71	60	.....	7.2	5.9	0.3	27.8	21.6	15.	3.6	3.3	3.0
Ball's White (Res.).....	40	25	.....	3.3	3.1	.....	28.2	20.0	.....	3.5	3.3	.....
Crego Shell Pink (Non-Res.).....	85	91	.....	8.2	7.4	.....	31.2	25.6	21.5	4.0	3.6	4.0
CregoRosePink (Non-Res.)...	71	62	.....	7.7	6.9	.....	28.9	24.1	.....	3.5	3.3	.....
Crego Deep Rose (Res.)..	62	68	.....	5.9	6.4	0.8	28.7	28.6	13.1	3.4	3.5	3.3
Early Royal Purple (Non-Res.).....	100	88	.....	26.6	16.7	6.3	18.4	22.3	16.0	2.5	2.8	2.5
Early Roya' Purple (Res.)	87	100	.....	16.9	18.7	9.6	24.6	22.7	18.0	2.7	2.6	1.9
Queen of the Market Purple (Non-Res.)	100	100	.....	13.8	14.3	8.6	19.2	17.6	16.0	2.5	2.3	1.7
Queen of the Market Dark Blue (Res.)..	100	100	.....	14.2	16.8	9.5	22.7	22.1	15.6	2.2	2.2	2.0
Astermum (Res.).....	90	60	.....	14.2	14.9	2.6	24.8	20.2	14.0	3.1	2.9	2.9
Amer. Branch Semple Pink (Res.).....	56	60	.....	6.2	7.3	0.3	26.4	25.6	11.6	3.3	2.9	3.0
Amer. Branch Azure Blue (Res.).....	36	43	.....	3.9	4.9	.....	27.7	24.5	.....	3.3	2.8	.....
Amer. Branch Phlox Pink (Res.).....	33	80	.....	4.7	5.5	.....	26.2	23.2	.....	3.0	3.0	.....
Calif. Giants Light Blue (Non-Res.)...	53	60	.....	3.5	4.8	.....	26.3	25.5	.....	3.7	3.5	.....
Calif. Giants Dark Purple (Non-Res.)...	30	30	.....	2.5	4.2	.....	24.9	24.0	.....	3.2	2.9	.....
Early Beauty Crimson (Res.).....	67	66	.....	5.6	7.1	.....	32.8	30.1	.....	3.0	2.7	.....
Ostrich Feather Deep Rose (Res.).....	26	40	.....	2.5	4.1	.....	29.6	29.2	12.0	3.7	3.6	3.5
Comet Pink (Res.).....	80	97	.....	16.0	18.4	2.1	22.1	21.6	14.0	3.0	3.0	2.5
New Giant Calif. Sunshine (Non-Res.).....	77	90	.....	8.2	8.0	0.1	24.9	24.3	13.5	3.2	3.0	3.0
Vaughan's Sunshine (Non-Res.)...	37	96	.....	10.5	20.5	0.9	23.8	24.8	14.0	3.0	2.8	2.5
Heart of France (Non-Res.).....	57	83	.....	7.4	11.4	.....	23.7	23.5	10.5	2.6	2.6	2.5
Heart of France (Res.)	77	77	.....	10.2	8.4	.....	21.8	23.7	12.0	2.7	2.7	2.7

*Plants were removed before wilt was present due to the presence of yellows.

The following is a list of materials used in constructing a cloth enclosure 96 feet long by 32 feet wide:

18	10′ cedar posts @ 69¢	$12.42
22	4″ x 4″ pine pieces	2.80
256	feet 6″ x ¾″ redwood boards	11.56
24	feet 2½″ x ¾″ redwood boards	0.63
45	pounds No. 10 wire @ 4¢	1.80
519	sq. yds. cloth @ 5¢	25.95
	String, nails, hinges, screws	0.42
36	hours labor for construction @ 35¢	12.60
28	hours labor for sewing @ 35¢	9.80
	Total	$77.98

The cost per square foot, up to the time of planting, amounted to 2½ cents. Allowing for the waste space used by walks, this amounts to 3¼ cents per plant.

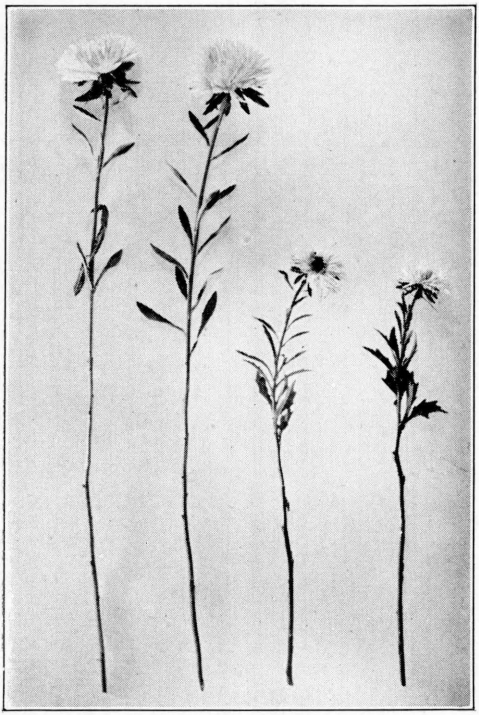

Fig. 3.—Asters grown outdoors and under cloth. Left—under cloth. Right—outdoors

Results with asters.—The culture of asters is complicated by the prevalence of wilt disease. As a consequence, resistant strains were tested in comparison with the non-resistant kinds. The seed was sown April 15; the plants were then "pricked off" into 2½-inch pots and were planted in the cloth house on May 21. The plants were set in beds 5½ and 6½ feet wide, placing the plants 12 x 12 inches.

Table 4 gives the results obtained with varieties of asters (*Callistephus chinensis*) grown under yellow cloth, white cloth, and out-of-doors. The data show a decided difference in the resistance of varieties to wilt.

No yellows was noted under the yellow or white cloth; whereas out-of-doors the entire crop, with the exception of the earlier varieties such as Queen of the Market, Early Royals, Astermum, and Comet Pink, was destroyed by yellows. The troubles experienced under the cloth enclosures were red spiders, black aphids, and rust.

The stem length and flower diameters were larger under the yellow cloth than under the white, but both types exceeded the stem length and diameter of those grown out-of-doors, Figure 3.

Results with miscellaneous annuals.—The data indicate that, although the production was somewhat variable, the length of stem and the diameter of flowers were greater in plots under cloth. The stiffness of stem and the quality of the flowers under cloth were superior to those grown outdoors, and the coloring of the flowers was more intense.

TABLE 5.—Effect of Cloth Enclosures on Miscellaneous Annuals

Variety	Average flowers per plant			Average stem length			Average flower diameter		
	Yellow cloth	White cloth	Open	Yellow cloth	White cloth	Open	Yellow cloth	White cloth	Open
	No.	*No.*	*No.*	*In.*	*In.*	*In.*	*In.*	*In.*	*In.*
Antirrhinum majus var. Cheviot Maid	18.0	26.8	20.0	14.5	16.8	10.7	.....	.....	.....
Antirrhinum majus var. Rose Queen	9.9	8.7	7.3	13.6	14.6	9.7	.....	.....	.....
Calendula officinalis var. Ball's Gold	9.7	10.0	7.0	21.2	17.8	11.2	2.3	2.3	2.0
Centaurea suaveolens	16.8	18.5	17.4	9.5	8.7	8.2	1.6	1.5	1.5
Chrysanthemum	18.9	34.0	11.1	16.1	13.9	8.2	1.8	2.0	1.3
Crepis barbata	69.1	71.2	29.3	12.2	12.5	8.0	1.5	1.3	1.0
Cynoglossum amabile	6.9	7.8	8.8	29.0	25.7	21.6	.....	.....	.....
Dahlia var. Jersey Beauty	21.7	33.0	13.0	14.3	7.8	7.0	6.5	4.5	3.0
Dahlia var. Princeps Victoria	41.8	37.0	9.7	11.2	11.5	6.0	3.0	3.0	2.5
Pentstemon gloxinioides var. Red Sensation	5.3	5.7	1.1	28.5	29.6	16.0	.....	.....	.....
Scabiosa Azure Fairy	25.1	40.8	25.3	10.8	12.2	10.0	1.9	1.9	1.5
Tagetes erecta var. Guinea Gold	72.4	75.5	40.8	16.9	14.6	8.5	3.0	2.1	2.0
Zinnia elegans	12.5	8.4	10.1	25.1	28.2	10.9	3.1	3.6	2.3

Results with pompon chrysanthemums.—Eleven varieties of pompon chrysanthemums were grown in plots under cloth and out-of-doors. Half of each plot was shaded with black cloth from July 15 to August 30 to reduce the day length to 10 hours, in accordance with the results on photoperiodism described in Bulletin 513 of the Ohio Experiment Station. Table 6 shows the results of the test.

The data show that pompon chrysanthemums may be grown in cloth enclosures satisfactorily and that earliness of flowering under yellow cloth may be attributed partially to the use of a heavier grade of black cloth under it than was used under the white cloth (Fig. 4). Length of stem and quality of flower showed great improvement over those grown in open ground, and, in addition to that, tarnished plant bug and other pests were eliminated from consideration. Outdoor plots showed so much damage and distortion from insect attacks that the flowers were not usable.

Discussion.—The fundamental factors which are responsible for the superior growth of plants under cloth enclosures are temperature, light intensity, and moisture (soil and air). Records collected during the past season showed that the air temperature was from 1 to 3 degrees higher under the cloth than outdoors; this was due to lack of circulation of air under cloth.

Light intensity was measured with slowly sensitized paper. A reduction of 12 units in intensity was obtained under yellow cloth and 6 to 8 units under white cloth, as compared with the light intensity outdoors. The difference between the two cloths varied from 4 to 10 units, depending upon the intensity of light in the open. When this intensity was high, the difference between the two cloths was greater than when the light intensity was low.

TABLE 6.—Effect of Short-day Treatment on Pompons Under Yellow Cloth, White Cloth, and Out-of-doors

Variety	First appearance of buds						Date of cutting						Average stem length					
	Yellow		White		Open		Yellow		White		Open		Yellow		White		Open	
	Short day	Normal day	Short day	Normal day	Short day	Normal day	Short day	Normal day	Short day	Normal day	Short day	Normal day	Short day	Normal day	Short day	Normal day	Short day	Normal day
Capt. Cook	Aug. 8	Sept. 12	Aug. 8	Sept. 12	Aug. 15	Sept. 12	Sept. 13	Nov. 1	Sept. 19	Nov. 1	*	*	39	53	39	50	.....	.....
Ethel	Aug. 6	Sept. 12	Aug. 6	Sept. 12	Aug. 15	Sept. 12	Sept. 9	Oct. 29	Sept. 15	Oct. 19	Sept. 21	.....	31	45	31	42	19	.... .
Firebird	Aug. 8	Sept. 12	Aug. 12	Sept. 12	Aug. 15	Sept. 12	Sept. 28	Oct. 21	Sept. 17	Oct. 21	Oct. 6	.....	32	42	25	40	21	.....
Irene	Aug. 6	Sept. 7	Aug. 8	Sept. 7	Aug. 15	Sept. 7	Sept. 5	Oct. 19	Sept. 9	Oct. 19	Oct. 6	.....	30	42	31	40	12	.....
Izola	Aug. 6	Sept. 15	Aug. 6	Sept. 15	Aug. 15	Sept. 15	Sept. 15	Oct. 1	Sept. 28	Oct. 1	Oct. 29	.....	30	41	28	41	20	.....
Maple Leaf	Aug. 8	Sept. 12	Aug. 12	Sept. 12	Aug. 15	Sept. 12	Sept. 28	Oct. 31	Sept. 28	Oct. 21	.....	.....	29	40	30	40	.....	.....
Mensa	Aug. 9	Sept. 18	Aug. 14	Sept. 18	Aug. 15	Sept. 18	Sept. 19	Nov. 3	Sept. 17	Nov. 3	.....	.....	36	49	27	48	.....	.....
Rodell	Aug. 4	Sept. 7	Aug. 7	Sept. 6	Aug. 15	Sept. 7	Sept. 7	Oct. 14	Sept. 9	Oct. 14	.....	.....	31	42	26	40	.....	.....
Silver Ball	Aug. 4	Sept. 7	Aug. 6	Sept. 7	Aug. 15	Sept. 7	Sept. 5	Oct. 19	Sept. 9	Oct. 19	Oct. 6	.....	36	48	34	45	18	.....
Varsity	Aug. 7	Sept. 12	Aug. 7	Sept. 12	Aug. 15	Sept. 12	Sept. 9	Oct. 25	Sept. 16	Oct. 25	.....	.....	31	47	29	45	.....	.....
White Doty	Aug. 7	Sept. 7	Aug. 8	Sept. 7	Aug. 15	Sept. 7	Sept. 13	Oct. 31	Sept. 17	Oct. 31	Sept. 29	.....	31	42	28	42	19	.....

*Flowers were disfigured due to attack by tarnished plant bug.

Soil moisture remained higher under the enclosure than out-of-doors. Air circulation increased the evaporation in the open. The plots under the cloth were watered six times, as compared with 19 times for the check. During the first part of the experiment no watering was necessary under the enclosure; the lack of soil moisture occurred during the latter part of August. The moisture in the air was higher inside after sunrise, but in the early morning the humidity outdoors exceeded that inside by 5 degrees. Later in the day the temperature was from 2½ to 10 degrees higher under cloth than outdoors.

The high humidity in the soil and the air, combined with decreased light intensity and high temperatures, are doubtless responsible for the elongation of stems and the increased size of flowers produced under cloth.

Conclusions.—1. The yellow cloth resisted the weather conditions much better than the white.

2. The earlier varieties are less susceptible to wilt than the later varieties.

3. The plants under the yellow cloth produced longer-stemmed flowers with larger diameters but the production was slightly lower than under the white cloth.

4. Queen of the Market and Early Royals were the only varieties that produced fair crops in the open. Yellows took the remaining varieties.

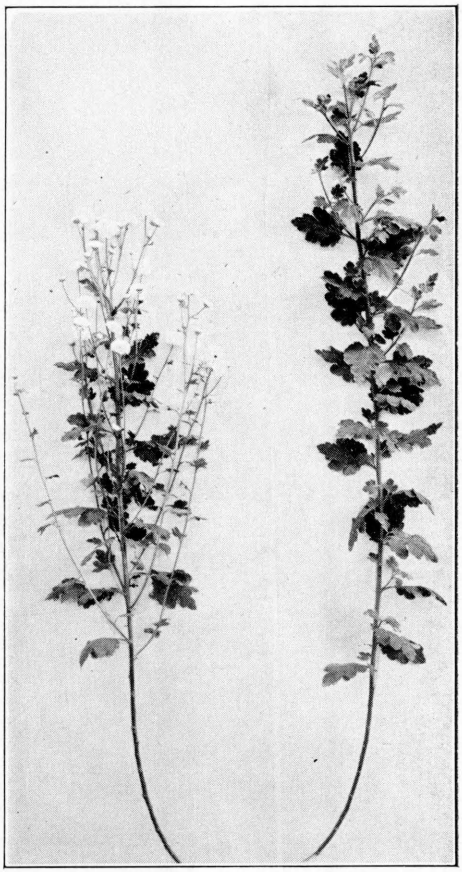

Fig. 4.—Effect of black shades on Pompon chrysanthemums. Left—shaded. Right—normal

5. This test indicates that it is difficult to grow asters in the open, due to the ravages of tarnished plant bug, aster beetle, and leafhopper.

6. Asters and other annuals growing under cloth need supports similar to those used in greenhouses for snapdragons and carnations.

7. Less frequent watering is necessary under cloth enclosures.

8. The color of the flowers is more brilliant under the cloth.

9. Pompon chrysanthemums grew to a height of 4 feet under the cloth; those in the open reached a height of 18 inches. The plants in the open did not produce marketable flowers.

10. Zinnia, Tagetes, annual Chrysanthemum, Pentstemon, snapdragon, Calendula, Cynoglossum, and Scabiosa flowered extremely well under both types of cloth.

11. The cost of construction was 2½ cents per square foot.

12. Dahlias should be grown under an enclosure at least 8 feet in height.

II. PERENNIALS

Perennials that are carefully chosen for correct habit of growth, size, texture, and color may be used in almost every conceivable place in the home garden. Among the most important uses of perennials are for borders, naturalizing, plantings near ponds and streams, covering of banks and terraces, edging, and background planting. The gardener is also confronted with the task of choosing types that will endure varying degrees of sunlight and

Fig. 5.—The Gasplant (Dictamnus) is hardy and permanent. It should be planted and left undisturbed

different types of soils. It is very important that continuous bloom be had in the perennial border. It is difficult to establish definite dates for perennial flower bloom. The major season of bloom may be set in many cases; in others, a more or less continuous bloom over a period of months makes this difficult. Changes in climatic conditions in different sections frequently produce abnormal seasonal bloom.

The following lists are presented as an aid to the proper selection and use of perennial plants. The heigths, where given, are approximate.

PERENNIALS ENDURING SHADY CONDITIONS

Aconitum fischeri (Azure Monkshood)
Ajuga genevensis (Geneva Bugle)
Amsonia tabernaemontana (Willow Amsonia)
Anemonella thalictroides (Rue-anemone)
Convallaria majalis (Lily-of-the-valley)
Cornus canadensis (Bunchberry)
Dicentra eximia (Fringed Bleedingheart)
Dodecatheon meadia (Shooting-star)
Helleborus niger (Christmas-rose)
Hosta caerulea (Blue Plantainlily)
Hosta plantaginea grandiflora (Big Plantainlily)
Lobelia cardinalis (Cardinalflower)
Mertensia virginica (Virginia Bluebells)
Myosotis palustris semperflorens (Dwarf Perpetual Forget-me-not)
Polygonatum biflorum (Small Solomonseal)
Thalictrum adiantifolium (Low Meadowrue)
Trillium grandiflorum (Snow Trillium)

PERENNIALS ENDURING SEMI-SHADY CONDITIONS

Anchusa italica (Dropmore Bugloss)
Anemone japonica (Japanese Anemone)
Aquilegia hybrids (Columbine)
Asperula odorata (Woodruff)
Belamcanda chinensis (Blackberry-lily)
Campanula rotundifolia (Harebell)
Chelone lyoni (Pink Turtlehead)
Cimicifuga racemosa (Cohosh Bugbane)
Digitalis purpurea (Common Foxglove)
Doronicum plantagineum (Leopardbane)
Heracleum villosum (Cow-parsnip)
Heuchera sanguinea (Coralbells)
Monarda didyma (Beebalm)
Primula veris (Cowslip Primrose)
Pulmonaria saccharata (Bethlehem Lungwort)
Silene pennsylvanica (Peatpink)
Trollius europaeus (Globeflower)

PERENNIALS REQUIRING WELL-DRAINED SITUATIONS

Arabis alpina (Alpine Rockcress)
Asclepias tuberosa (Butterflyweed)
Aubrietia deltoidea (Purple Rockcress)
Coreopsis grandiflora (Tickseed)
Delphinium hybrids (Delphinium)
Dianthus barbatus (Sweet-william)
Digitalis purpurea (Common Foxglove)
Echinops ritro (Steel globethistle)
Eryngium maritimum (Seaholly)
Gaillardia aristata (Blanketflower)
Globularia trichosantha (Globedaisy)
Helianthus maximiliani (Maximilian Sunflower)
Iris germanica (German Iris)
Liatris pycnostachya (Cattail Gayfeather)
Papaver nudicaule (Iceland Poppy)

PERENNIALS FOR DRY, SANDY SOILS

Achillea ptarmica (Sneezewort)
Ajuga reptans (Geneva Bugle)
Anthemis tinctoria (Yellow Camomile)
Asclepias tuberosa (Butterflyweed)
Aster novae-angliae (New England Aster)
Callirhoe involucrata (Poppymallow)
Cassia marilandica (Wild Senna)
Coreopsis grandiflora (Tickseed)
Dianthus plumarius (Grass Pink)
Echinops ritro (Steel Globethistle)
Euphorbia corollata (Flowering Spurge)
Helianthus (various) (Sunflower)
Limonium latifolium (Statice) (Bigleaf Statice)
Lychnis chalcedonica (Maltese Cross)
Papaver nudicaule (Iceland Poppy)
Rudbeckia laciniata (Goldenglow)
Yucca filamentosa (Common Yucca)

PERENNIALS FOR WET SITUATIONS

Arundo donax* (Giant Reed)
Asclepias incarnata (Swamp Milkweed)
Boltonia asteroides (White Boltonia)
Caltha palustris* (Marshmarigold)
Eupatorium purpureum (Joe-pye-weed)
Helenium autumnale (Sneezeweed)
Hibiscus moscheutos (Rosemallow)
Iris pseudacorus* (Yellowflag)
Iris versicolor* (Blueflag)
Lobelia cardinalis (Cardinalflower)
Lysimachia clethroides (Clethra Loosestrife)
Lythrum salicaria (Loosestrife)
Miscanthus sinensis (Eulalia)
Monarda didyma (Beebalm)
Myosotis palustris (True Forget-me-not)
Onoclea sensibilis (Sensitive Fern)
Osmunda cinnamonea (Cinnamon Fern)
Osmunda regalis* (Royal Fern)
Sarracenia purpurea (Pitcherplant)

*May be grown in water.

PERENNIALS FOR BORDERS OF PONDS AND STREAMS

(Well-drained soil)

SUNNY LOCATIONS

Anchusa myosotidiflora (Siberian Bugloss)
Chrysanthemum uliginosum (Giant Daisy)
Cimicifuga racemosa (Cohosh Bugbane)
Grasses (Ornamental grasses)
Hemerocallis (various) (Daylily)
Iris (various) (Iris)
Lythrum salicaria (Loosestrife)
Myosotis palustris semperflorens (Dwarf Perpetual Forget-me-not)
Chrysanthemum uliginosum (Giant Daisy)
Tradescantia virginiana (Spiderwort)
Trollius europaeus (Globeflower)

SEMI-SHADY LOCATIONS

Anemone japonica (Japanese Anemone)
Cimicifuga racemosa (Cohosh Bugbane)
Epimedium macranthum (Longspur Epimedium)
Eupatorium purpureum (Joe-pye-weed)
Ferns (Ferns)
Iris cristata (Crested Iris)
Lythrum salicaria (Loosestrife)
Tradescantia virginiana (Spiderwort)

PERENNIALS FOR NATURALIZING

Asclepias tuberosa (Butterflyweed)
Aster (various) (Aster)
Cimicifuga racemosa (Cohosh Bugbane)
Convallaria majalis (Lily-of-the-valley)
Coreopsis grandiflora (Tickseed)
Geranium maculatum (Spotted geranium)
Helianthus (various) (Sunflower)
Hemerocallis (various) (Roundlobe Hepatica)
Lythrum salicaria (Loosestrife)
Mertensia virginica (Virginia Bluebells)
Monarda didyma (Beebalm)
Physostegia virginica (False Dragonhead)
Polemonium reptans (Creeping Polemonium)
Rudbeckia subtomentose (Sweet Coneflower)
Sanguinaria canadensis (Bloodroot)
Smilacina racemosa (False Solomonseal)
Solidago canadensis (Canada Goldenrod)

PERENNIALS FOR GROUND COVER

SUNNY LOCATIONS

Cerastium tomentosum (Snow-in-summer)
Ceratostigma plumbaginoides (Larpente Plumbago)
Coronilla varia (Crownvetch)
Dianthus plumarius (Grass Pink)
Helianthemum mutabile (Fickle Sunrose)
Iberis sempervirens (Evergreen Candytuft)
Nepeta mussini (Mussini Mint)
Phlox subulata (Moss Phlox)
Sedum sarmentosum (Stringy Stonecrop)
Sedum spurium (Running Stonecrop)
Thymus serphyllum (Mother-of-thyme)
Veronica teucrium (rupestris) (Rock Speedwell)
Vinca minor (Periwinkle)

SHADY LOCATIONS

Aegopodium podograria (Goutweed)
Ajuga reptans (Geneva Bugle)
Asperula odorata (Woodruff)
Convallaria majalis (Lily-of-the-valley)
Hedera helix (English Ivy)
Mitchella repens (Partridgeberry)
Nepeta mussini (Mussini Mint)
Pachysandra terminalis (Japanese Pachysandra)
Sedum ternatum (Mountain Stonecrop)
Vinca minor (Periwinkle)

PERENNIALS FOR COVERING BANKS AND TERRACES

Ajuga reptans (Geneva Bugle)
Alyssum saxatile (Goldentuft)
Arabis alpina (Alpine Rockcress)
Cerastium tomentosum (Snow-in-summer)
Coronilla varia (Crownvetch)
Dianthus deltoides (Maiden Pink)
Hedera helix (English Ivy)
Nepeta mussini (Nepeta)
Pachysandra terminalis (shade) (Japanese Pachysandra)
Phlox subulata (Moss Phlox)
Saponaria ocymoides (Rock Soapwort)
Sedum sarmentosum (Stringy Stonecrop)
Veronica teucrium (rupestris) (Rock Speedwell)
Vinca minor (Periwinkle)

PERENNIALS FOR EDGING

Aegopodium podograria (Goutweed)
Ajuga reptans (Geneva Bugle)
Alyssum saxatile compactum (Dwarf Goldentuft)
Arabis alpina (Alpine Rockcress)
Bellis perennis (English Daisy)
Campanula carpatica (Carpathian Bellflower)
Cerastium tomentosum (Snow-in-summer)
Ceratostigma plumbaginoides (Larpente Plumbago)
Dianthus plumarius (Grass Pink)
Festuca glauca (Blue Fescue)
Heuchera sanguinea (Coralbells)
Iberis sempervirens (Evergreen Candytuft)
Papaver nudicaule (Iceland Poppy)
Primula veris (Cowslip Primrose)
Sedum album (White Stonecrop)
Sedum reflexum (Jenny Stonecrop)
Statice armeria (Thrift)
Tunica saxifraga (Tunicflower)
Veronica teucrium (rupestris) (Rock Speedwell)
Viola cornuta (Tufted Pansy)

PERENNIALS FOR BACKGROUND PLANTING

Althea rosea (Hollyhock)
Aster novae-angliae (New England Aster)
Aster tataricus (Tatarian Aster)
Bocconia cordata (Plumepoppy)
Boltonia asteroides (White Boltonia)
Campanula pyramidalis (Chimney Bellflower)
Cimicifuga racemosa (Cohosh Bugbane)
Delphinium hybrids (Delphinium)
Helenium autumnale (Sneezeweed)
Helianthus maximiliani (Maximilian Sunflower)
Hibiscus grandiflorus (Great Rosemallow)
Rudbeckia laciniata (Goldenglow)
Solidago altissima (Tall Goldenrod)
Valeriana officinalis (Common Valerian)
Yucca filamentosa (Common Yucca)

PERENNIALS SUITABLE FOR CUT FLOWERS

Achillea millefolium rosea (Pink Yarrow)
Anemone japonica (Japanese Anemone)
Aster (various) (Aster)
Chrysanthemum maximum (Shasta Daisy)
Coreopsis grandiflora (Tickseed)
Delphinium hybrids (Delphinium)
Dianthus barbatus (Sweet-william)
Gaillardia aristata (Blanketflower)
Gypsophila paniculata (Babysbreath)
Helenium autumnale (Sneezeweed)
Iris (various) (Iris)
Paeonia (various) (Peony)
Pyrethrum roseum (Painted Lady)
Rudbeckia (various) (Coneflower)
Salvia azurea grandiflora (Azure Sage)
Veronica longifolia subsessilis (Clump Speedwell)

FRAGRANT PERENNIALS

Centranthus ruber (Jupitersbeard)
Convallaria majalis (Lily-of-the-valley)
Dianthus plumarius (Grass Pink)
Hemerocallis flava (Lemon Daylily)
Hosta plantaginea grandiflora (Big Plantainlily)
Lathyrus grandiflorus (Perennial Pea)
Valeriana officinalis (Common Valerian)
Viola cornuta (Tufted Pansy)

NEW OR UNCOMMON PERENNIALS WORTHY OF EXTENSIVE USE

Aquilegia, Copper Queen
Aster, Climax
Chrysanthemum mortifolium (Mulberry Chrysanthemum)
Delphinium, hybrids
Doronicum caucasicum (Caucasian Leopardbane)
Geum, Lady Stratheden
Inula royleana (Blackbud Inula)
Linum capitatum
Phlox, Africa
Phlox, Mia Ruys

PERENNIALS FOR MARCH BLOOM

Scientific Name	Common Name	Height, in Inches	Color
Helleborus niger	Christmas Rose	12	White
Iberis sempervirens	Evergreen Candytuft	12	White
Sanguinaria canadensis	Bloodroot	8	White
Galanthus nivalis	Common Snowdrop	6	White
Scilla siberica	Siberian Squill	6	Blue
Chionodoxa luciliae	Glory-of-the-snow	4	Blue
Claytonia virginica	Virginia Springbeauty	4	Pink
Crocus vernus	Common Crocus	4	Various
Eranthis hyemalis	Winter-aconite	3	Yellow

PERENNIALS FOR APRIL BLOOM

Scientific Name	Common Name	Height, in Inches	Color
Cheiranthus cheiri	Common Wallflower	24	Yellow
Iberis gibraltarica	Gibraltar Candytuft	18	White
Aquilegia canadensis	American Columbine	18	Red-Yellow
Dodecatheon meadia	Common Shootingstar	15	Lilac
Saxifraga cordifolia	Heartleaf Saxifrage	12	Purple
Pulmonaria angustifolia	Cowslip Lungwort	12	Blue
Mitella diphylla	Common Bishopscap	12	White
Arabis alpina	Alpine Rock Cress	12	White
Adonis amurensis	Amur Adonis	12	Yellow
Tulipa (Early)	Tulip	12	Various
Narcissus (Various)	Narcissus	12	Yellow
Leucojum vernum	Spring Snowflake	12	White
Dicentra cucullaria	Dutchman's Breeches	10	White
Primula elatior	Oxlip Primula	9	Various
Primula veris	Cowslip	9	Yellow
Anemone pulsatilla	European Pasqueflower	9	Purple
Viola cornuta	Tufted Pansy	8	Various
Viola odorata	Sweet Violet	8	Violet
Muscari botryoides	Common Grape-hyacinth	8	Blue
Hyacinthus orientalis	Hyacinth	8	Various
Hepatica triloba	Roundleaf Hepatica	6	Blue
Aubrietia deltoidea	Common Aubrietia	6	Purple

PERENNIALS FOR MAY BLOOM

Dicentra spectabilis	Bleedingheart	36	Pink
Iris germanica	Iris	18-36	Various
Thalictrum aquilegifolium	Columbine Meadowrue	36	Purple
Hemerocallis flava	Lemon Daylily	36	Yellow
Paeonia officinalis	Common Peony	30	Various
Aquilegia chrysantha	Golden Columbine	24	Yellow
Doronicum caucasicum	Caucasian Leopardbane	24	Yellow
Euphorbia epithymoides	Cushion Spurge	24	Yellow
Chrysanthemum coccineum	Painted Lady	24	Various
Trollius europaeus	Common Globeflower	24	Yellow
Alyssum saxatile	Goldentuft	18	Yellow
Tulipa gesneriana	Darwin Tulip	18	Various
Gaillardia aristata	Common Peren. Gaillardia	15	Red-Orange
Anchusa myosotidiflora	Siberian Bugloss	12	Blue
Convallaria majalis	Lily-of-the-valley	12	White
Nepeta mussini	Mussini Mint	12	Blue
Phlox divaricata	Blue Phlox	12	Lavender
Asperula odorata	Sweet Woodruff	8	Yellow
Ajuga reptans	Carpet Bugle	6	Purple
Phlox subulata	Moss Phlox	6	Pink
Polemonium reptans	Creeping Polemonium	6	Blue
Ranunculus repens	Creeping Buttercup	6	Yellow
Silene alpestris	Alpine Catchfly	6	White
Cerastium tomentosum	Snow-in-summer	6	White
Veronica teucrium (rupestris)	Rock Speedwell	4	Blue

PERENNIALS FOR JUNE BLOOM

Althea rosea	Hollyhock	72	Various
Astilbe davidi	David Astilbe	60	Rose
Delphinium hybrids	Larkspur	24-60	Various
Digitalis purpurea	Common Foxglove	48	Purple
Lilium regale	Royal Lily	48	White
Anchusa italica	Italian Bugloss	36	Blue
Gypsophila paniculata	Babysbreath	36	White
Lupinus polyphyllus	Washington Lupinus	36	Various

Scientific Name	Common Name	Height, in Inches	Color
Pentstemon barbatus torreyi	Torrey Pentstemon	36	Scarlet
Papaver orientale	Oriental Poppy	36	Red-Pink
Lilium candidum	Madonna Lily	36	White
Aconitum napellus	Aconite	24	Blue-White
Baptisia australis	Blue Wild-indigo	24	Blue
Campanula medium	Canterbury-bells	24	Blue
Chrysanthemum maximum	Shasta Daisy	24	White
Platycodon grandiflorum	Balloonflower	24	Blue-Violet
Achillea ptarmica	Sneezewort	24	White
Lilium tenuifolium	Coral Lily	24	Red
Achillea millefolium rosea	Common Yarrow	18	Rose
Centranthus ruber	Jupitersbeard	18	Crimson
Dianthus barbatus	Sweet-william	18	Various
Linum perenne	Perennial Flax	18	Blue
Oenothera fruticosa	Common Sundrops	18	Yellow
Dianthus plumarius	Grass Pink	12	Various
Lychnis viscaria	Clammy Campion	12	Purple
Papaver nudicaule	Iceland Poppy	12	Various
Thalictrum minus adiantifolium	Maidenhair Meadowrue	12	Yellow
Veronica spicata	Spike Speedwell	12	Purple
Astilbe japonica	Japanese Astilbe	12	White
Dianthus deltoides	Maiden Pink	9	Pink
Campanula carpatica	Carpathian Bellflower	8	Blue

PERENNIALS FOR JULY BLOOM

Bocconia cordata	Pink Plume Poppy	72-96	Cream
Lilium tigrinum	Tiger Lily	24-60	Orange
Cimicifuga racemosa	Cohosh Bugbane	48	White
Hemerocallis thunbergi	Japanese Daylily	48	Yellow
Lythrum salicaria	Purple Loosestrife	48	Rose-Purple
Heliopsis pitcheriana	Pitcher Heliopsis	36	Orange
Physostegia virginiana vivid	Virginia False-dragonhead	36	Pink
Monarda didyma	Oswego Beebalm	36	Scarlet
Echinops ritro	Steel Globethistle	36	Blue
Phlox paniculata	Garden Phlox	24	Various
Asclepias tuberosa	Butterflyweed	24	Orange
Lychnis chalcedonica	Maltese Cross	24	Scarlet
Eryngium amethystinum	Amethyst Eryngo	24	Amethyst
Lychnis haageana	Haage Campion	12	Orange-Scarlet
Heuchera sanguinea	Coralbells	18	Crimson
Veronica incana	Woolly Speedwell	12	Rosy purple
Tunica saxifraga	Tunicflower	8	White

PERENNIALS FOR AUGUST BLOOM

Eupatorium purpureum	Joe-pye-weed	72	Purple
Campanula pyramidalis	Chimney Bellflower	72	Blue
Lilium henryi	Henry Lily	60-72	Orange
Artemisia vulgaris lactiflora	White Mugwort	48	White
Liatris pycnostachya	Cattail Gayfeather	48	Purple
Lilium speciosum	Speciosum Lily	24-48	Pink
Solidago canadensis	Canada Goldenrod	36	Yellow
Rudbeckia speciosa	Showy Coneflower	36	Golden
Lilium superbum	American Turkscap Lily	24-36	Orange-Red
Veronica longifolia subsessilis	Clump Speedwell	24-36	Blue-Purple
Inula royleana	Blackbud Inula	24	Golden
Aster spectabilis	Seaside Aster	24	Purple
Liatris spicata	Spike Gayfeather	24	Purple
Stokesia laevis	Stokesia	12-24	Lavender-White
Limonium latifolium	Bigleaf Sea-lavender	20	Lavender
Coreopsis rosea	Rose Coreopsis	12	Pink-Rose
Hosta plantaginea	White Plantainlily	12-18	White
Colchicum autumnale	Common Autumn Crocus	3-4	Purple

PERENNIALS FOR SEPTEMBER AND OCTOBER

Scientific Name	Common Name	Height, in Inches	Color
Boltonia asteroides	White Boltonia	60-72	Creamy
Aster tataricus	Tatarian Aster	60-72	Violet-Blue
Boltonia latisquama	Violet Boltonia	48-72	Pink
Chrysanthemum uliginosum	Giant Daisy	60	White
Aconitum wilsoni	Violet Monkshood	48-60	Blue
Aster novibelgi	New York Aster	36-60	Blue
Salvia azurea grandiflora	Great Azure Sage	48	Blue
Aster novae-angliae	New England Aster	36-48	Various
Helenium autumnale	Common Sneezeweed	36-48	Yellow
Kniphofia uvaria	Common Torchfly	36	Orange
Echinacea purpurea	Purple Coneflower	36	Purple-Rose
Anemone japonica	Japanese Anemone	24-36	Various
Chelone lyoni	Pink Turtlehead	24-36	Pink
Aconitum fischeri	Azure Monkshood	24-36	Blue
Salvia patens	Gentian Sage	12-24	Blue
Sedum spectabile	Showy Stonecrop	18	Crimson
Eupatorium coelestinum	Mistflower	18	Blue
Anemone hupehensis		12	Rose
Chrysanthemum arcticum	Arctic Chrysanthemum	6	White
Ceratostigma plumbaginoides	Larpente Plumbago	6	Blue

III. ROSES

The lists indicated include various classes, species, and varieties of roses which will be found useful for planting in every rose garden and landscape development. The varieties of climbers, Polyanthas, Hybrid Teas, and Hybrid Perpetuals, with the exception of the newer types that have not as yet been extensively tested, are those that should prove easy to grow and give the least trouble to rose lovers. It should be understood, however, that all of these varieties, to be at their best, should receive careful attention. The various large-growing species are useful for mass effects.

Time of planting.—Roses may be planted either in the fall or in the spring. If they are planted early enough in the fall, that season is preferable to spring. There are advantages and disadvantages for both times of planting. The fall-planted material is freshly dug; whereas spring-planted stock must have been held in storage over winter, with the possibility of drying and shriveling. If planted in the fall, the plants will become established before winter sets in and these plants will be ready to start active growth in the spring; whereas those planted in the spring will not be started until midsummer. The plants are received from the nursery in a dormant condition. After arrival unpack them at once, place the roots in water for an hour, and then plant. If impossible to plant upon arrival, the roses should be heeled-in in a trench and covered with soil until ready. Proper planting distances vary with different varieties. Most of the Hybrid Teas and Baby Ramblers should be planted about 18 inches apart; whereas the stronger-growing Hybrid Perpetuals may be set 24 inches each way. The *rugosa* and similar types should be allowed at least 4 or 5 feet; the hybrid wichuraianas and multifloras require 6 to 8 feet.

Planting consists of digging a hole large enough to permit the roots to be spread out. The plant is then pruned by trimming all bruised roots and cutting back the tops in accordance with the type of the rose. The Hybrid Perpetuals may be cut back to seven or eight buds from the base, with five or six stems left on each plant. The Hybrid Teas should be cut back more severely;

four buds should be left on four or five stems. The climbers should be cut back to force them to make a heavy root system, which in turn will produce long shoots and canes.

Each plant should be set so that the union of bud and stock is slightly below the surface of the ground. "Own root" roses should be planted at the same depth as in the nursery; however, deeper planting is advisable in light soils. The soil should be packed thoroughly about the roots to produce intimate contact with the roots. After planting, a liberal mulch of manure, leaf mold, or peat moss should be placed about each plant.

ROSE TYPES AND RELIABLE VARIETIES

Ground Cover

Rose wichuraiana
Rosa Max Graf*

Climbers

American Pillar—Crimson-pink
Blaze*—Scarlet
Chaplin's Pink Climber*—Pink
Christine Wright—Rose-pink
Dorothy Perkins—Blush-pink
Dr. W. Van Fleet—Pink
Evangeline—Carmine-pink
Excelsa—Scarlet-crimson
Gardenia—Yellow
Hiawatha—Crimson
Mary Wallace—Pink
New Dawn*—Pink
Paul's Scarlet Climber—Scarlet
Silver Moon—White
Tausendschön—Rose

Polyanthas

Eblouissant—Dark red
Echo—Soft pink
Erna Teschendorff—Deep crimson
Gloria mundi*—Orange
Golden Salmon*—Golden salmon
Ideal—Dark scarlet
LaMarne—Salmon-rose
Miss Edith Cavell—Brilliant scarlet
Mrs. R. M. Finch*—Rose-pink
Triomphe Orleanais—Cerise-red

Hybrid Teas

Betty Uprichard—Salmon-pink
Countess Vandall*—Carmine pink, buff, and gold
Dame Edith Helen—Pink
Duchess of Wellington—Golden orange
Etoile de Hollande—Red
Everest*—White
General MacArthur—Red
Gruss an Teplitz—Crimson
Joanna Hill—Salmon-yellow
Kaiserin Auguste Victoria—White
Lady Alice Stanley—Deep rose
Lady Ashtown—Pink
Lady Margaret Stewart—Golden yellow
Laurent Carle—Crimson
Mary Hart*—Red
Mme. Butterfly—Pink suffused gold
Mrs. Caroline Testout—Pink
Radiance—Light pink
Talisman—Scarlet-orange

Hybrid Perpetuals

Anna de Diesbach—Rose carmine
Avrillago*—Pink
Frau Karl Druschki—White
George Arends—Light pink
J. B. Clark—Light red
Magna charta—Light pink
Margaret Dickson—White
Mrs. John Laing—Light pink
Paul Neyron—Rose-pink
Ulrich Brunner—Red

Landscape Roses

Rosa blanda—Light pink
Rosa canina—Light pink
Rosa carolina—Rose pink
Rosa hugonis—Yellow
Rosa lucida—Bright pink
Rosa multiflora—White
Rosa nitida—Deep pink
Rosa palustris—Rose pink
Rosa rubiginosa—Bright pink
Rosa rubrifolia—Pink
Rosa rugosa—Pink
Rosa setigera—Bright pink
Rosa spinosissima—White
Rosa xanthina—Yellow

*Signifies new or uncommon varieties.

IV. HARDY BULBS

Hardy flowering bulbs are seldom used to the extent they should be in our gardens. With the proper selection of different kinds they may be had in bloom from early March until late summer. They are especially desirable for their early spring bloom through March, April, and May when other flowers are scarce.

Ways of using bulbs.—Practically all kinds may be planted in the hardy flower border. Placed between the perennials, most of them will bloom in the spring before the others are well under way. The later ones will grow up between the perennials and bloom above them. Bulbs planted in the borders should be in masses rather than individually or in narrow rows. Bulbs may be planted in front of the shrub border or the earlier ones among the shrubs where they will bloom before the woody plants leaf out. Bulbs may be naturalized in the wild garden or in the edges of the lawn. They may be planted in the rock garden or around the pool. For cut flowers they may be set in rows in the vegetable or cutting garden.

Time of planting.—Bulbs should be planted as soon as they arrive in the fall. The earlier the planting the larger the root system will grow before the ground freezes and the better the flowers will be the following year. Lilies do much better if they are planted in early fall, with the exception of *Lilium candidum* which should be planted in August. Narcissi and tulips may be planted in October or November. Later plantings may be successful but, in general, are not advisable.

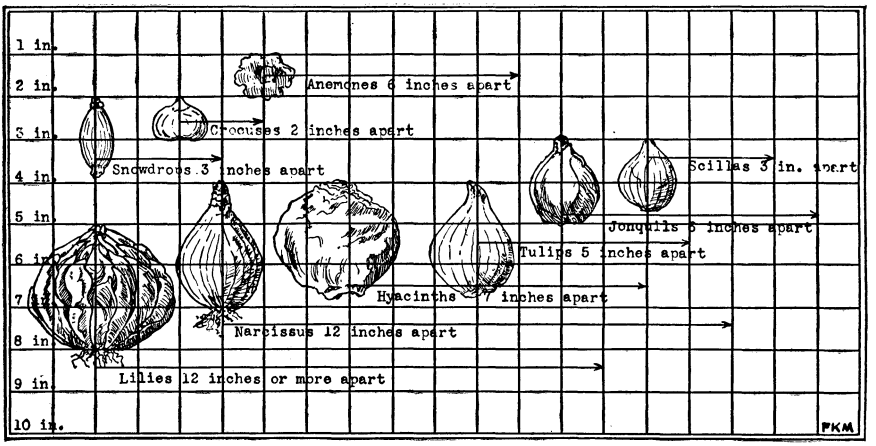

Fig. 6.—Depth of planting bulbs

Method of planting.—In planting bulbs there are two general methods used. One method is to place the bulbs on the surface of the bed where they are to be planted and then plant each bulb in an individual hole dug by a trowel. It is important in placing the bulb in this hole that the base be placed on soil and not in an air pocket at the bottom. This is one reason why a trowel is better than a pick or crowbar.

The other method, used particularly in formal gardens or large beds, is to remove the top soil from the entire bed to the depth to which the bulbs are to be planted, set the bulbs in place, and shovel the soil back. This method may

be used only where there are no perennials and is usually more laborious than necessary for home planting. If the soil is heavy and the drainage poor, a little cushion of sand should be placed under the bulbs to assure freedom from decay due to an excess of moisture. Lilies in particular should be given this treatment.

Each type of bulb has a more or less optimum depth at which it should be planted. If the soil is extremely light and sandy, bulbs may be planted deeper than if the soil is heavy clay. In general, bulbs are planted from two to three times their own depth beneath the surface.

When to lift.—Bulbs should be lifted only after the foliage is fully yellow. For tulips and narcissi this should be done in June. If it is impossible to transplant at this time, the bulbs should be left in the ground until fall. Narcissi should be lifted at least every 3 years. Tulips and other spring-flowering bulbs need not be moved until they become crowded, usually about every 2 or 3 years.

To avoid sunscald, do not allow the bulbs to lie on the ground after they are dug. Dry the bulbs in trays or bags in the open or in an airy cellar or shed. These bulbs should then be planted the following autumn. It should be understood that narcissus and tulip bulbs form the embryo flower buds during the summer months. Therefore, excellent storage conditions should be provided.

SUMMER FLOWERING BULBS

Galtonia candicans—Summer Hyacinth
Lilium auratum—Japanese Lily
Lilium canadense—Canada Lily
Lilium candidum—Madonna Lily
Lilium elegans
Lilium henryi—Henry Lily
Lilium regale—Royal Lily
Lilium superbum—Turkscap Lily
Lilium tigrinum—Tiger Lily

BULBS FOR NATURALIZING

Camassia (Camass)
Crocus vernus
Lilium canadense (Canada Lily)
Lilium superbum (Turkscap Lily)
Lilium tigrinum (Tiger Lily)
Lilium umbellatum (Western Orange Cup Lily)
Muscari botryoides (Grape Hyacinth)
Narcissus (Daffodil)
Scilla (Squill)

BULBS FOR SHADE

Camassia
Crocus
Lilium canadense
Narcissus

BULBS FOR ROCK GARDENS

Tulips

Tulips are the mainstay of any bulb garden, for, if the proper selection of types and varieties is made, they may be had in bloom for a period of 6 weeks. To secure this period of bloom the following types should be used.

1. Early tulips are, with the possible exception of some of the wild species, the first to bloom. The double varieties bloom earlier than the single but, being lower, are often splashed with mud. The average height of early tulips is from 10 to 18 inches.

2. Darwin tulips are the best known type, varying in color from white to pink red and purple, usually in solid colors. Their large broad flowers are carried on stems from 18 to 36 inches high. The height and time of bloom depend on the variety. The individual varieties may be planted or varieties may be used in mixture. Many prefer the mosaic effect of a high grade mixture.

3. Breeder tulips resemble the Darwins in shape, growth, and time of bloom. They are distinguished by their difference of coloring, being for the most part blends of apricot, orange, bronze, lilac, purple, rose, and yellow.

4. Cottage tulips are very different in effect due to their long, narrow flowers and narrow, pointed petals. Their simple colors and graceful flowers add an airiness to the tulip bed.

5. Parrot tulips are unique rather than beautiful with their ragged edged petals and usually weak, sprawly stems.

6. Triumph and Mendel tulips are new types earlier than Darwin but with large, massive flowers.

Narcissi and Daffodils

Narcissi or daffodils add to the spring garden. By the careful selection of varieties of the different types they will furnish bloom over a period of at least 6 weeks. They may be naturalized, planted through the flower border, or among the shrubs. They need little attention and bloom freely.

Of the various types the following are the more important for garden use. The varieties belonging to each may be selected from any bulb catalog.

1. The Trumpet group has a long crown or trumpet as long as, or longer than, the saucer or perianth. They may be all yellow or bi-color with yellow and white.

2. The Incomparabilis or half-cup group has the cup not less than one-third the width of the saucer.

3. The Barrii group has the cup less than one-third the width of the saucer.

4. The Leedsii group usually has short trumpets with a white perianth or saucer.

5. The Jonquil group is distinguished by narrow grass-like foliage with two or more flowers on a stem. They are often fragrant.

6. The Tazetta or Polyanthus group has many flowers to a stem. This includes the common Paper White Narcissus.

7. The Poet's group has very flat cups with a dark red edge.

ROCK GARDENS

A rock garden properly made, placed in a suitable place, and planted with the right kind of plants is an attractive feature. Otherwise, it becomes an ugly and unattractive spot. Rock gardens should not be made just to have one or to be in style but because of an interest in rock plants or the necessity of planting a naturally rocky slope. They should be made only after some time and study have been given to them.

TYPES OF ROCK GARDENS

There are several distinct types of rock gardens. The simplest is a walk or terrace paved with roughly fitted stone and interplanted with rock plants.

The dry wall is the next simplest and easiest to make and the type which should be used along many terraces or banks fronting the street, instead of the naturalistic type. It is merely a stone wall with soil instead of mortar between the rocks.

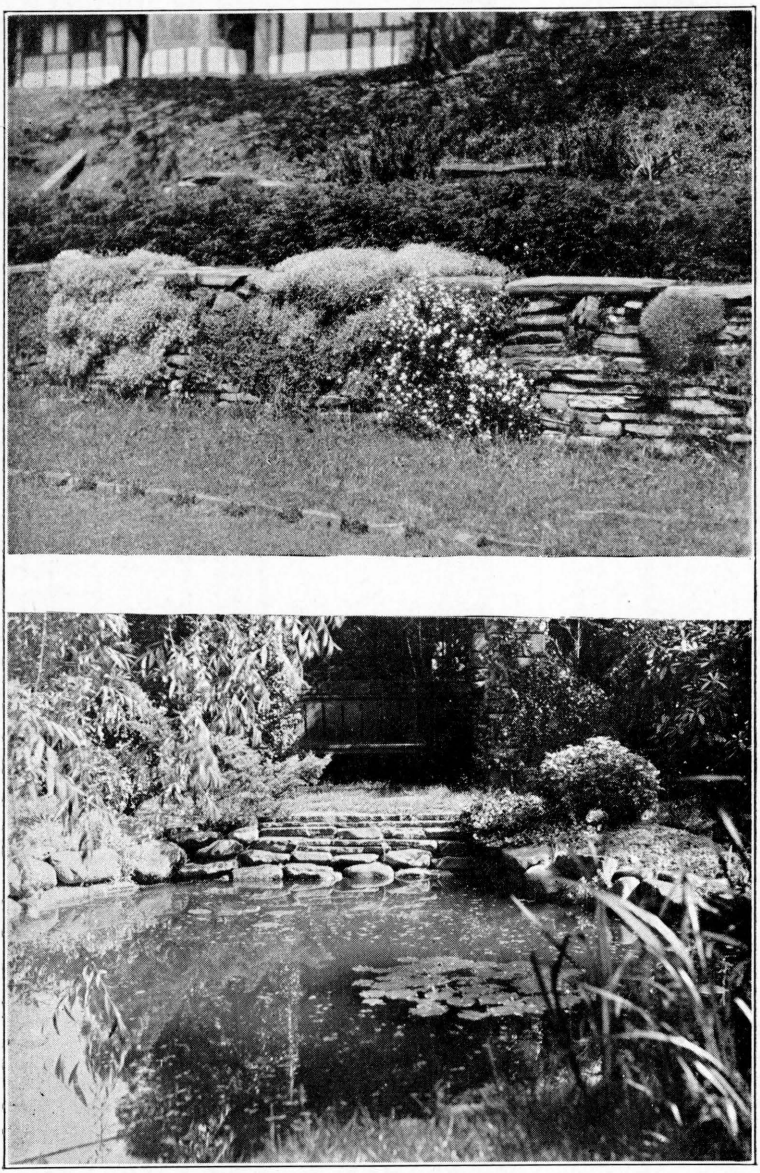

Fig. 7.—*Top.*—**A stone wall may be used in many ways. Using soil instead of mortar, it may be planted with various rock plants.** *Bottom.*—**A cool, secluded pool hidden in a corner of the garden.**

The naturalistic rock garden is the type most often attempted but very seldom successful. It should generally be hidden away in the seclusion of the back yard and so placed many times that it may not be visible from the house. It is best placed on a natural slope, the direction of which is immaterial except for the more sensitive alpine plants which prefer an east exposure.

Full, or nearly full, sun will prove advantageous. Avoid places beneath trees or near tree roots. Perfect drainage is essential.

If the garden is developed on level ground (unless it is in a large yard), it is best to keep it low and sprawling. A maximum height of 15 or 18 inches will be much easier to make appear natural than a greater height.

Unless the rock garden is on a natural slope, a background of shrubs or evergreens will usually prove effective. Even on a slope a low background will add to the picture.

ROCK

Use only well-weathered rocks. They should be at least 25 pounds, and preferably 50 pounds, in weight, with some of 100 pounds or more. Limestone and sandstone are preferable, but boulders may be used. Bury one-half of each rock, especially boulders, with the weathered side up. Place all rocks horizontally, never on end, and slanting back slightly into the bank. Limestone and sandstone should be placed in layer effects as they occur in nature. Each individual rock should be firm enough and large enough to stand upon while caring for the garden. The effect, even before planting, should be as natural as possible.

ROCK PLANTS

Although all kinds of plants are used as rock plants and called such, many of them are unfitted for this purpose. Rock plants are, in general, low growing. Those suggested on Pages 40, 41, and 42 will be found very satisfactory. Some of them may be grown from seed; others will have to be purchased.

Planting.—The planting of rock garden plants is very similar to that of other plants. The plants may be set either in early fall or during the spring. The planting consists of digging a hole large enough to receive the ball of the plant. The compacting of soil about the roots and the elimination of air spaces are essentials to good planting.

Each individual plant must be given a thorough soaking so that the water will permeate the ball of the plant and come into direct contact with the roots and the nearby soil.

VIGOROUS PLANTS FOR THE BEGINNER'S ROCK GARDEN

Achillea tomentosa (Millifoil)
Alyssum saxatile (Goldentuft)
Anchusa myosotidiflora (Bugloss)
Aquilegia nivea (Columbine)
Arabis alpina (Rock Cress)
Asperula odorata (Woodruff)
Campanula carpatica (Bellflower)
Cerastium tomentosum (Snow-in-summer)
Dianthus caesius (Cheddar Pink)
Dianthus deltoides (Maiden Pink)
Gypsophila repens (Creeping Gypsophila)
Helianthemum mutabile (Sunrose)
Heuchera sanguinea (Coralbells)
Iberis sempervirens (Candytuft)
Iris pumila
Myosotis palustris semperflorens (Forget-me-not)
Nepeta mussini (Catnip)
Phlox subulata (Moss Pink)
Primula polyantha (Primrose)
Polemonium reptans (Creeping Polemonium)
Saponaria ocymoides (Rock Soapwort)
Sedum album (White Stonecrop)
Sedum ellacombianum (Stonecrop)
Sedum reflexum (Stonecrop)
Sedum spurium coccineum (Stonecrop)
Sempervivum soboliferum (Hen and chickens)
Sempervivum tectorum (Roof houseleek)
Teucrium chamaedrys (Germander)
Thymus serpyllum (Thyme)
Tunica saxifraga (Coatflower)
Veronica incana (Speedwell)
Veronica teucrium (rupestris) (Speedwell)
Viola Jersey Gem (Violet)

CHOICE BUT MORE DIFFICULT ROCK PLANTS

Aethionema pulchellum (Stonecress)
Anemone pulsatilla (Windflower)
Aubrietia deltoidea (Purple Rockcress)
Campanula garganica (Bellflower)
Campanula rotundifolia (Harebell)
Ceratostigma (Plumbago larpentae)
Dicentra eximia (Dutchman's Breeches)
Hypericum repens
Mazus reptans
Myosotis alpestris (Alpine Forget-me-not)
Papaver nudicaule (Iceland Poppy)
Primula japonica (Japanese Primrose)
Saxifraga McNabbiana
Saxifraga cordifolia (Heartleaf Saxifrage)
Sedum dasyphyllum (Stonecrop)
Sedum middendorfianum (Stonecrop)
Sedum sieboldi (Stonecrop)
Sempervivum arachnoideum (Spiderweb Houseleek)
Sempervivum rubicundum
Silene alpina (Catchfly)
Silene maritima
Talinum calycinum
Thymus languinosus (Thyme)
Trollius sieboldi (Globeflower)
Veronica pectinata (Speedwell)
Viola pedata bicolor (Birdsfoot Violet)

DWARF SHRUBS FOR ROCK GARDENS

Abelia grandiflora
Berberis thunbergi minor (Barberry)
Cotoneaster horizontalis
Potentilla fruticosa (Cinquefoil)
Stephanandra flexuosa

DWARF EVERGREENS FOR ROCK GARDENS

Chamaecyparis obtusa nana (Dwarf Hinoki Cypress)
Daphne cneorum (Garlandflower)
Euonymus radicans (Evergreen Wintercreeper)
Euonymus radicans minimus
Juniperus horizontalis (Creeping Juniper)
Pinus montana mughus (Swiss Mountain Pine)
Taxus cuspidata nana (Japanese Yew)

PLANTS SUITABLE FOR THE SHADED ROCK GARDEN

Most rock garden and alpine plants demand more or less full sun, thereby indicating that a sunny situation is best for the average rock garden. Circumstances, however, may be such that the garden must be placed in the shade, and then the following plants, a number of them native wild flowers, will be found satisfactory:

Adonis vernalis (Spring Adonis)
Ajuga reptans (Carpet Bugle)
Allium moly (Lilyleek)
Anchusa myosotidiflora (Bugloss)
Anemone canadensis (Meadow Anemone)
Aquilegia caerulea (Colorado Columbine)
Arabis alpina (Rockcress)
Arenaria balearica (Sandwort)
Arenaria montana (Mountain Sandwort)
Asarum canadense (Wildginger)
Asperula cynanchica (Woodruff)
Asperula odorata (Woodruff)
Asplenium trichomanes (Maidenhair Spleenwort)
Camassia esculenta (Camass)
Campanula rotundifolia (Bellflower)
Cypripedium pubescens (Ladyslipper)
Delphinium tricrone (Larkspur)
Dentaria diphylla (Crinkleroot)
Dicentra eximia (Fringed Bleedingheart)
Dodecatheon meadia (Shooting Star)
Epimedium macranthum
Hepatica triloba
Hosta (Funkia) (Plantainlily)
Helleborus niger (Christmas Rose)
Iris cristata (Crested Iris)
Mentha requieni (Mint) (moist soil)
Mertensia virginica (Virginia Bluebells)
Mitchella repens (Partridgeberry) (acid soil)
Myosotis palustris semperflorens (Forget-me-not)
Oxalis violacea (Violet Woodsorrel)
Pachysandra terminalis (Japanese Pachysandra)
Phlox divaricata (Blue Phlox)
Phlox subulata (Moss Pink)
Polypodium vulgare (Common Polypody)
Polystichum acrostichoides (Christmas Fern)
Primula (Various) (Primrose)
Pulmonaria saccharata (Bethlehem Lungwort)
Sanguinaria canadensis (Bloodroot)
Saxifraga umbrosa (Londonpride Saxifrage)
Saxifraga virginiana (Virginia Saxifrage)
Sedum nevi (Stonecrop)
Sedum pulchellum (Stonecrop)
Sedum ternatum (Stonecrop)
Silene pennsylvanica (Peatpink)
Silene virginica
Trillium grandiflorum (Snow Trillium)
Trollius europaeus (Globeflower)
Viola (Various) (Violet)

GROUND COVER PLANTS FOR ROCK GARDENS

Ajuga reptans (Carpet Bugle)
Arabis alpina (Rockcress)
Campanula carpatica (Bellflower)
Cerastium tomentosum (Snow-in-summer)
Dianthus deltoides (Maidenpink)
Euonymus radicans minimus
Myosotis palustris semperflorens
Nepeta mussini (Catnip)
Phlox subulata (Moss Pink)
Saponaria ocymoides (Rock Soapwort)
Sedum album (Stonecrop)
Sedum spurium (Stonecrop)
Thymus serpyllum (Thyme)
Veronica filiformis (Speedwell)
Veronica pectinata (Speedwell)
Veronica teucrium (rupestris) (Speedwell)

BULBS FOR THE ROCK GARDEN

Camassia esculenta—Camass
Chionodoxa lucileae—Glory-of-the-snow
Colchicum—Autumn Crocus
Crocus—Crocus
Eranthis hyemalis—Winter Aconite
Fritillaria meleagris—Guinea Hen Flower
Galanthus nivalis—Snowdrop
Lilium tenuifolium—Coral Lily
Muscari botryoides—Grape Hyacinth
Narcissus—smaller varieties, especially Poet's and Jonquils
Puschkinea sciloides—Striped Squill
Scilla bifolia—Squills
Scilla campanulata
Scilla nutans
Scilla siberica
Tulipa clussiana
Tulipa greigi
Tulipa kaufmanniana

ROCK PLANTS FOR WALKS AND STEPPING STONES

Arenaria balearica
Arenaria verna (Sandwort)
Herniaria glabra (Burstwort)
Linaria equitriloba (Toadflax)
Thymus serpyllum (Thyme)
Thymus serpyllum coccineum (Thyme)
Thymus serpyllum lanuginosus (Thyme)
Veronica filiformis (Speedwell)
Veronica repens

ROCK PLANTS FOR WET GROUND

Coptis trifolia (Goldthread)
Mentha requieni (Mint)
Mimulus ringens (Monkeyflower)
Myosotis palustris semperflorens
Primula japonica
Sedum pulchellum (Stonecrop)
Sedum ternatum (Stonecrop)
Veronica filiformis (Speedwell)
Viola blanda (Sweet White Violet)
Viola palustris (Violet)

WATER GARDENS

A water garden may be developed in almost any yard or garden. However, for water lilies to bloom successfully, full sun is needed.

TYPES OF POOLS

The formal pool should be more or less geometric in shape with a well-defined, nicely-finished margin of smooth concrete, brick, or flat, matched stone. The top should be only a few inches, if any, above the surrounding ground level. Boulders or stones on edge as a margin seldom add to the attractiveness. Bird baths or large fountains in the center of small pools do not add to their beauty. Rock gardens, unless in the form of a paved walk or stone wall, are seldom in keeping with a formal pool.

The informal or naturalistic pool should usually be set off to one side of the yard or in the corner. It should have the concrete completely hidden by being an inch or two lower than the ground level and covered by plants, sod, or an occasional rock. The more natural you can make it appear, the better. If a rock garden is made in connection with a pool it should be very low and naturalistic.

BACKGROUND

Most pools require a background of shrubs and flowers to set them off to advantage, except formal pools set in the center of a lawn or garden.

WATER

Running water is not essential and is often detrimental. Water lilies prefer warm, stagnant water. Additional water may be added by a hose or pail as needed during the summer.

MAKING A POOL

A half barrel, a wooden or galvanized tub, or an old watering trough may be used by sinking them in the ground so that the top is level with the surface of the ground. Even a concrete pool is not difficult to make. Dig the hole 24 to 26 inches deep, leaving sloping sides. Line the pool with a 6-inch layer of concrete reinforced with heavy fence wire. Use a mixture of one part cement, two parts sand, and three parts gravel or crushed stone. No forms will be necessary if a stiff mixture is used. Tamp the concrete well. The pool should be at least 3 feet wide and as long as desired. One lily fills a 3-foot width, two a 5-foot width. Rocks cemented together are seldom permanent and soon leak (Fig. 8).

After the concrete has hardened, fill the pool with water and allow to stand several days to remove excess lime. Do this twice before putting in plants and fish. A drain, although convenient, is not necessary as a pool may be siphoned or bailed out very easily. A few gold fish will keep down the mosquitoes.

PLANTS FOR WATER GARDENS

HARDY WATER LILIES

RED—Gloriosa
PINK—Morning Glory
Pink Opal
Comanche
YELLOW—Chromatella
Sunrise
WHITE—Gladstone
Gonnere

TROPICAL WATER LILIES

Day Blooming:
WHITE—Mrs. Geo. H. Pring
BLUE—Pennsylvania
Mrs. Ed. Whitaker
PURPLE—Panama Pacific
PINK—Zanzibariensis rosea

Night Blooming:
WHITE—Juno
PINK—Peter Bissett
RED—George Huster

MARSH PLANTS FOR SHALLOW WATER

Arrowhead	Parrotfeather	Pickerelweed
Lizardtail	Umbrella-sedge	Papyrus
Waterpoppy	Variegated Sweetflag	Water Arum

OXYGENATING PLANTS

Water-Hyacinth	Waterlettuce	Salvinia

POOL TROUBLES

The common complaint of pool owners is that the water becomes green and cloudy. This is due to the development of algae in the water. If persistent, it may be controlled by dissolving ½ ounce of blue vitriol to 125 cubic feet of water. A greater amount than this will prove toxic to the fish.

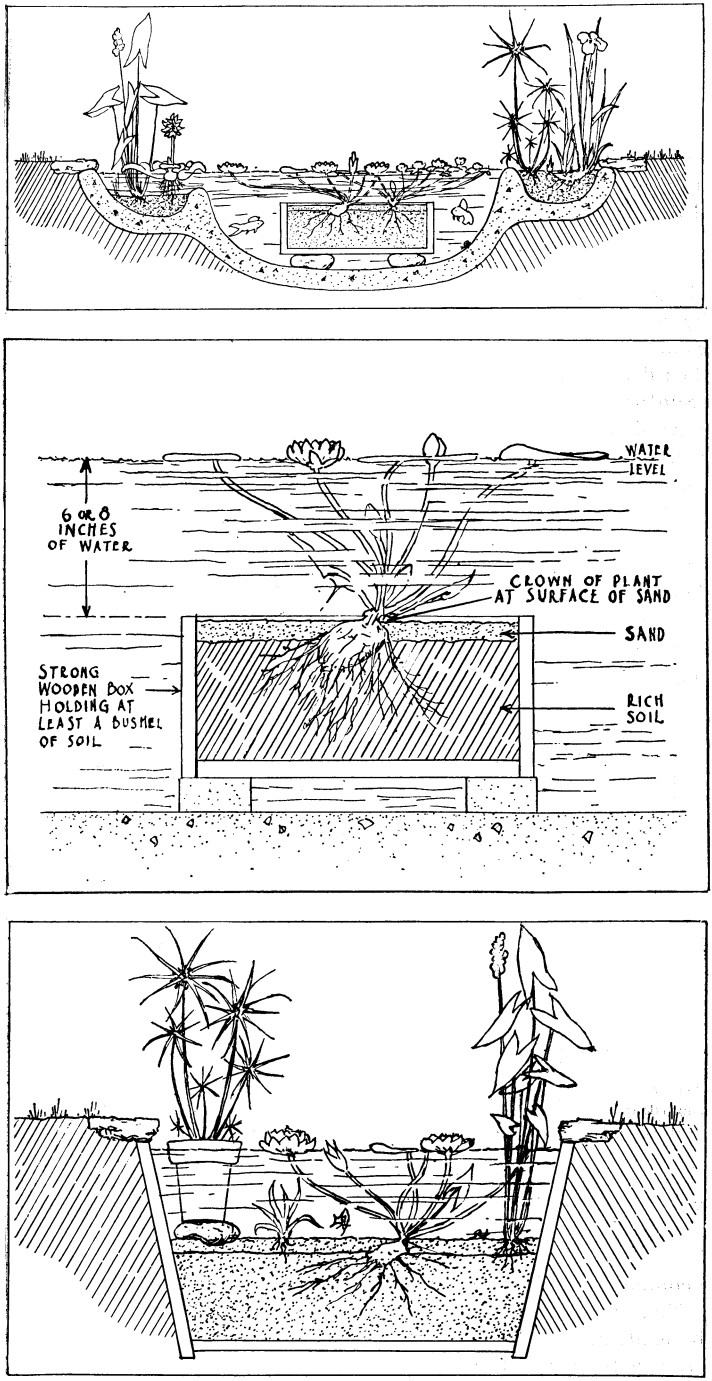

Fig. 8.—Diagram showing construction of water gardens

Cloudiness of water in small pools may be due to excess feeding of fish.

Aphids on the water lily foliage may be controlled by spraying with a pyrethrum spray, using one teaspoonful to a gallon. Add one ounce of soap.

CARE OF GOLDFISH IN POOLS

Fish are essential to every pool for the control of mosquitoes. The best fish for this purpose are gold fish. They are perfectly hardy and, provided the pool does not freeze solid and is not filled with leaves, may be left out all winter. If the pool does freeze solid, the fish may be brought into the house either in an aquarium or in tubs in the cellar. Unless running water is used, the tanks should be in the sunlight and planted with oxygenating plants to keep the water fresh. If this is properly done and the quantity of fish not too great for the tank, the water will not require changing all winter.

Goldfish, when kept inside, should be fed not oftener than three times a week; outside they need not be fed at all. Give them only as much food as they eat immediately; otherwise, the excess food will foul the water.

Fish die easily from lack of oxygen in the water, from over-feeding, from decaying excess food or dead fish, or from a sudden change of temperature in changing from one tank or pool to another. A difference of a few degrees may be fatal.

SUMMER CARE OF THE GARDEN

Adequate care of garden plants in summer is one of the vital points in the successful development of a garden.

Weed control.—It is essential that no weeds be allowed to develop and grow in any part of the garden. In most cases they may be controlled by regular cultivation. Occasionally, more drastic methods may be used, as in the case of quack grass and thistles. Information on the control of these may be obtained from Ohio Experiment Station Bulletin 475, "Ohio Weeds".

Cultivation serves in controlling weeds, aerating the soil, and in absorption of rainfall; some gardeners also believe it aids in the conservation of moisture. Cultivation may be done with a hoe, tooth cultivator, or wheel hoe. It should be done as often as a new crop of weeds develops or as required by compacting of the soil.

Mulching.—Mulching may be done for summer as well as winter. In summer a mulch may be used as a substitute for cultivation. It acts as a weed control, conserves soil moisture, absorbs rainfall, and tends to keep the soil temperature lower and more uniform. A mulch is especially advantageous on flower borders or beds. Mulches, such as peat moss, cottonseed hulls, buckwheat hulls, rotted manure, or similar materials, may be used. These should be applied in the spring for greatest benefit, although they may be applied any time during the growing season. A 1- or 2-inch layer will prove adequate. All mulching materials should be thoroughly moistened before application or thoroughly watered afterwards. In either case considerable mixing will be required to saturate the mulch material thoroughly.

This mulch should be left on all winter and spaded into the soil the following spring to form additional humus. A new mulch should be applied as soon as possible. This procedure is recommended for most annuals, perennials, and even shrub and evergreen plantings.

It is highly satisfactory for roses, except that Hybrid Petpetual and Hybrid Tea roses should be treated as suggested on Page 48 during the winter months.

Watering may be replaced to some extent by the use of a mulch. When a mulch is not used or the season is exceptionally dry, artificial watering will prove desirable and often absolutely necessary.

Watering.—Artificial watering, to be economical, should be thorough. Applications should be adequate rather than frequent. At any watering sufficient water should be supplied to soak the soil to a depth of at least 3 or 4 inches. To do this with a hand nozzle is almost impossible. Some type of sprinkler must be used. For portable hose, a rotary type giving a uniform distribution of water over the entire area will be adequate. For larger areas, a pipe system supported on posts with nozzles at regular intervals in the pipe will prove more efficient.

Disease control.—No garden will prove a complete success unless the various diseases are adequately controlled. Complete instructions for their control will be found in Ohio Experiment Station Bulletin No. 511.

Tools.—Gardening is made considerably easier by the use of the proper tools kept in good condition. On the other hand, a large variety of highly specialized tools becomes a nuisance.

All tools should be kept sharpened and cleaned. This is especially true for hoes, spades, and shovels.

Care of plants.—For the appearance of the garden, as well as succession of bloom, all old flowers and seed pods, except those few to be saved for seed, should be removed as soon as possible. Sick and diseased plants, if not easily curable, should be removed and burned to remove any chance of further infection.

Show flowers.—To obtain large flowers, especially on asters, dahlias, zinnias, and similar plants, all side buds should be removed, leaving only a few flowers to each plant. This will produce large-flowered, long-stemmed specimens. Disbudding of these types should be done early before side buds have developed to any extent. This throws all the energy of the stem into the one flower.

Pruning of roses.—Hybrid Perpetuals should be cut back to six or seven buds from the bottom of each strong cane. Hybrid Teas will require a more severe cutting back to four or five buds. This will provide quality flowers. Climbing roses should be pruned in the spring by the removal of 2-year-old canes. Polyantha and large growing hardy types need a yearly thinning but no cutting back.

WINTER PROTECTION OF PLANTS

The successful wintering of plants is not difficult if the causes of winter injury are known and their control understood. Most winter losses are avoidable if proper precautions are taken.

Factors causing winter injury and their control.—Most garden plants are easily injured and killed by excessive moisture in the soil during the winter months; this is especially true of roses. It may be corrected by the laying of adequate lines of drainage tile beneath the bed or garden to carry the water to a lower place or to a dry well.

Sudden changes of temperature from that at which growth is active to below freezing will result in injury to some plants. Alternate freezing and thawing, so common in sections having little snow, is the cause of heaving of plants from the soil as well as slowly causing the death of some of the less hardy types. The injurious effects of temperature changes may be prevented by the application of a mulch.

It should be remembered that low temperatures alone seldom cause damage. It is the change of temperature that is to be guarded against. The popular idea that winter protection consists of keeping plants warm is erroneous.

Wind is especially injurious in some sections. A steady winter wind exerts a considerable drying influence, often to the extent of complete killing. Although usually not as serious to garden flowers as to woody plants, it may damage evergreen, rock, and perennial plants. A windbreak of shrubs or evergreens or the planting of tender plants in a location naturally protected from prevailing winds is advisable. A burlap, paper, or cloth screen will often prove practical.

The sun, during February and March especially, is a factor in winter injury due to its warming effect either by thawing or possibly to the extent of starting plant growth. A mulch, a shade, or a northern exposure will prove successful for the protection of more sensitive plants against this warming influence.

Plants weakened either by disease, insects, or improper cultivation are usually the first to be injured. This will also include those plants stimulated into late growth by late applications of nitrogenous fertilizers.

Tender plants which demand a milder climate usually suffer heavy winter losses. If control of the above factors does not winter them successfully, it is advisable to grow them in a cold frame covered with glass sash and wooden shutters during the winter.

Over-mulching, either by the use of a heating mulch of fresh manure, the application of a mulch before cold weather, or the use of a mat-forming mulch such as maple leaves which form a wet, air-tight layer, or the late removal of a mulch in the spring may cause severe injury.

Preventive measures.—The various methods of winter protection may be used with varying degrees of success, depending on the plant material and the conditions.

Mulching is the commonest type of protection and involves the use of straw, peat moss, leaves, manure, evergreen branches, corn stalks, excelsior, or similar material. Such a mulch, except peat moss, should not be applied until

cold weather, the last of November or early December. In most instances, the mulch may be applied directly to the ground, but in the case of fleshy plants, such as foxglove and most rock plants, it should be kept off the plants themselves by branches, lath or baskets, or a loose material such as excelsior. A thin, ½-inch layer of peat moss will also prove efficient. All mulches except peat moss should be removed in the spring, after freezing weather is past, before the plants start to grow.

The use of burlap or evergreen branches as a shade will often prove as efficient as a mulch. Perfect drainage is necessary as a winter protection for most plants.

Winter protection of roses.—Hybrid Tea and Hybrid Perpetual roses are best protected by hilling soil around each plant to a depth of 6 to 8 inches after the first hard frost. This will prevent drying out, will keep out field mice, and will lessen the temperature changes to a considerable extent. After freezing weather an additional protection in the form of a 4-inch mulch of straw, leaves, or manure may be placed over the entire bed.

The perennial border, depending on the plants grown, the section of the State, the location and exposure, may or may not need a winter mulch.

The rock garden will come in the same category. Most of the common rock plants are perfectly hardy provided the proper soil has been used. The more tender rock plants are best protected with excelsior or, in a few cases such as Saxifrages, with a piece of glass or shingle to keep excessive winter moisture from them.

DIGGING, CURING, CLEANING, AND STORAGE

GLADIOLUS

The new corms are ready to dig as soon as the foliage turns yellow, about 6 weeks after blooming. If they are allowed to become fully ripe, there is danger of losing many cormlets at digging. A number of methods is employed in digging, but on a small scale the easiest way is to cut the tops off within 2 inches of the ground, insert a spading fork under the row of plants and lift them out carefully. These should then be stored in an airy, frost-proof shed for about 2 weeks to aid proper maturity. Each variety should be labeled and placed in shallow trays or paper bags. To insure no mixtures the name should be written on the bag or tray and a label inserted in the container as well.

Before storing for the winter the corms should be cleaned. The old mother corm which was planted in the spring, together with the roots, should be removed from the new corms and cormlets. The former may be placed in trays, and the latter will go in bags unless they are in large quantity. The trays should be spaced when piled on top of one another to facilitate air circulation and curing. The use of peat moss is desirable for hard shelled cormlets.

Gladiolus corms are graded according to size:

No. 1—1½ inches and up
No. 2—1¼ to 1½ inches
No. 3—1 to 1¼ inches
No. 4—¾ to 1 inch
No. 5—½ to ¾ inch
No. 6—below ½ inch

The blooming sizes are Nos. 3, 2, and 1, although No. 4 and sometimes even smaller sizes may flower during the season. Some varieties do not produce large corms, and, as a consequence, their scale of sizes varies somewhat. Sizing of stock may be accomplished by grading boards or wire screens for the amateur grower.

A fruit cellar is an ideal place to store gladiolus corms. The temperature should be 40 to 45 degrees F., the air fairly humid (80 per cent), and the cellar well ventilated. The critical time comes in the spring, since a rise of temperature is apt to cause the starting of growth. This may be deleterious if the growth develops into shoots over 2 inches long. The brittle growth may be broken off in planting and handling; this will delay development and weaken the plants.

DAHLIAS

The roots should be dug as soon as the frost has killed the tops. They may be left out to dry for a day before removing to a cool (40 to 45° F.), moist cellar. The roots may be packed in barrels of sawdust or sand or placed in boxes or bins, provided the humidity is fairly high in the cellar. The notion that all roots should be stored tops down is erroneous. There is no advantage in such a practice. The roots keep just as well stored with the tops up, a procedure which causes less injury from handling.

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